International Marine Engineering

SEPTEMBER, 1907.

THE NEW INDIAN LINER CITY OF LONDON.

BY BENJAMIN TAYLOR.

To the Ellerman Lines, Limited, a notable addition has again been made from the shipyard of Workman, Clark & Co., Limited, Belfast. The *City of London* is the sixteenth vessel constructed by this firm for the City Line. She is a handsomely modelled vessel of 8,800 tons, 507 feet in length, with a beam of 57 feet 6 inches, and a depth of 35 feet 3 inches, built under the special survey of the British Corporation of Shipping, to qualify for their highest class. She is built of steel with two complete steel decks, a cellular double bottom, and poop, bridge and forecastle erections. There are seven watertight transverse bulkheads, and as boilers, locomotives, motor cars, and machinery. The hatchways to these holds are equipped with three and four winches each, all of the largest and most powerful type. Derricks are swung from the masts and crane posts. The bottom of the vessel is constructed on the double-bottom system, which, besides adding to the safety of the vessel, is used for water ballast for trimming purposes. Bilge keels are fitted, to limit rolling.

The passenger accommodation throughout is admirable. The first-class rooms are placed amidships, on the upper bridge and promenade decks. The state-rooms are exceptionally large and

THE STEAMER CITY OF LONDON AT SEA.

every provision made throughout for the safety of the ship. The vessel is specially designed for the eastern passenger and cargo traffic, and is one of the most comfortable and luxurious steamers in the eastern trade. The Ellerman-City liner *City of York* has just completed a record passage from Liverpool to Bombay, having covered the whole distance in twenty days. By this fast steaming passengers to India can embark at Liverpool a day later than passengers sailing from London, and arrive out in equally good time. The passage from Liverpool will be still further reduced by the *City of London,* which began her maiden trip to Bombay and Karachi on February 21.

The cargo space is divided into five large holds, which, by the adoption of the girder system of construction, are free from obstruction, and are capable of receiving large cargo bulks, such well lighted, and one of the features is the Bibby tandem arrangement, by which the inner rooms have the benefit of being lighted and ventilated like the outer rooms. A number of cabins de luxe with lavatories adjoining are on the bridge and promenade decks. Many of these rooms are provided with bedsteads in place of berths, and all have electric radiators and light, and ventilating fans operated at will.

All the public rooms have been designed and decorated with a view to comfort and with taste. The dining saloon, seating 160, is at the forward end of the bridge deck, fitted with necessary table accommodation and accessories. This room is lighted by large cottage windows in the sides and front, and by a stained glass dome through a large well overhead. The paneling is in the most beautifully marked quartered fumed oak, relieved by

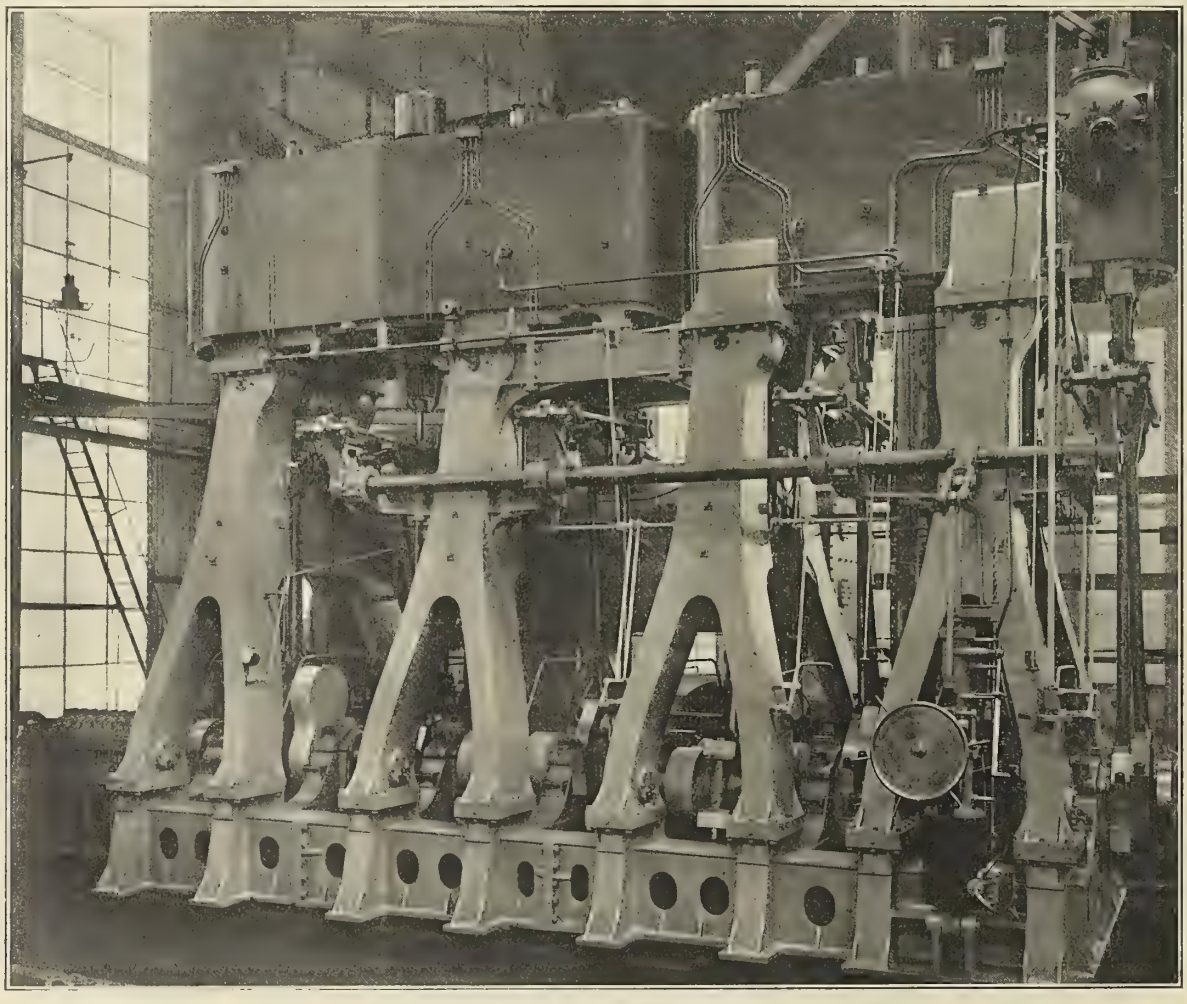
bronzing, and a number of bright blue and white medallion cameos. On the same deck a roomy nursery, with lavatory adjoining, is provided for the use of nurses and children. Each panel represents, in oils, some well known nursery tale.

On the promenade deck are two large deckhouses. In the forward house a commodious entrance hall, with balustrade stairway down to the dining saloon, and an artistically designed and furnished music room, are located. Both of these apartments are lighted by cottage windows and by skylights overhead. The entrance is wainscoted in light polished oak, and the flooring is laid in rubber tiling. The music and lounging room is situated just above the main saloon. A handsome alcove divides it from the main companionway. The walls are paneled, and relieved with Adams' decorations and small medallion paintings in Bartolozzi style. The finish is in white enamel and old gold. The room is surmounted by a very effective stained glass semi-circular dome. The settees, chairs, writing tables and piano are of mahogany; the upholstery of old rose frieze velvet, with Wilton carpet to match. In the afterhouse is the smoke room, with a bar adjoining. This room is paneled in polished hard wood, furnished in walnut, and decked with a polished oak parquetry, with exceedingly rich effect. At the after end of this house is an alcove for the convenience of those who desire a lounge in the open air. The bridge and promenade decks have been arranged so as to have as large an area as possible for games and promenading, and deck seats are placed in sheltered recesses. A well-equipped gymnasium is also provided. A plunge bath has been fitted up in the after well.

The second-class passengers are accommodated in the poop, their staterooms and dining saloon being large and roomy apartments. In a steel house on the poop deck are their music room and smoke room. The crew's quarters are aft, and are arranged to suit the requirements of the Lascars, who form the principal portion of the ship's complement.

The lavatory arrangements throughout all the passenger spaces have received the most careful attention. Porcelain tiles are laid, but a rubber tread is arranged alongside all the baths. The commissariat departments are admirably arranged, with the most up-to-date appliances for efficiently supplying the full complement of passengers.

The propelling machinery consists of a set of quadruple expansion engines with cylinders 31¾, 45, 64 and 92½ inches in diameter respectively, a piston stroke of 60 inches, piston speed of 750 feet per minute (75 revolutions per minute), and with a capacity of 6,500 indicated horsepower. The condenser is of the cylindrical type supported on the back columns well above the starting platform, so as to admit of a clear view and give ample space for working.



STARBOARD SIDE OF THE QUADRUPLE EXPANSION ENGINE OF THE CITY OF LONDON.

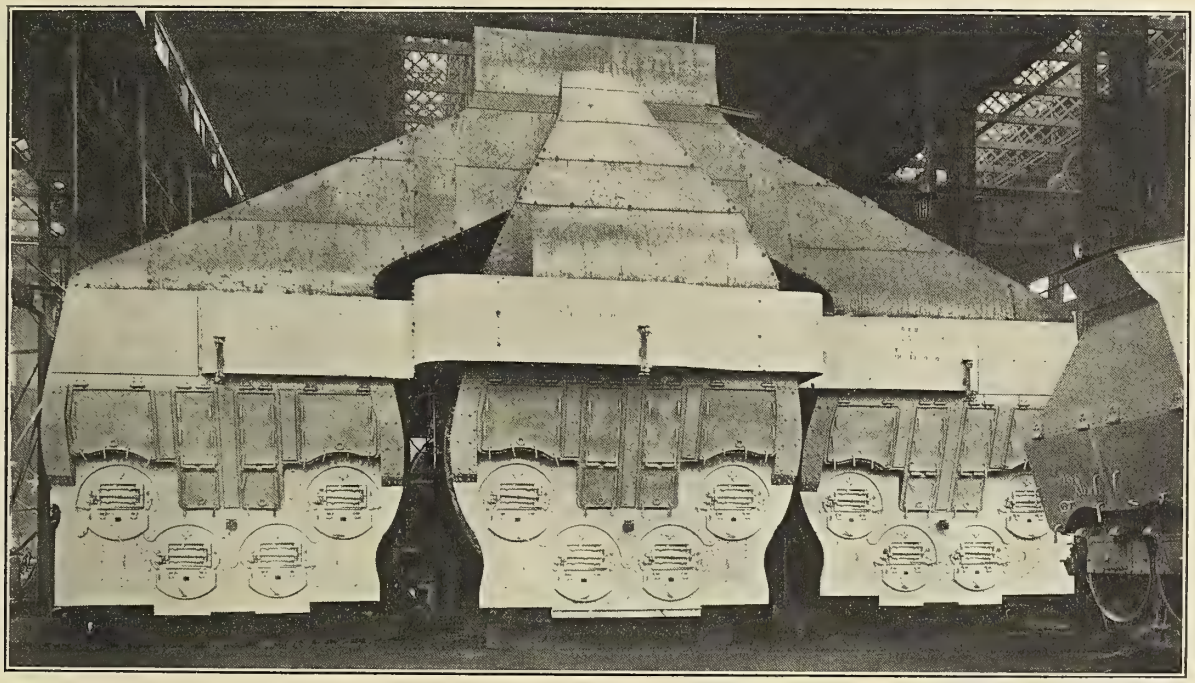
The auxiliary machinery is of the latest type and consists of Edwards' air pump; Weir's feed heaters and feed pumps; Edminston's filter; a Morison's 50-ton evaporator; Carruthers' general service and ballast pumps; See's ash ejector; large centrifugal circulating pump; auxiliary winch condenser and drain tanks, etc. Steam is supplied by two single and two double ended steel multitubular boilers, working at 215 pounds pressure. Howden's system of forced draft is used, the fan being placed in the engine room. The furnaces are Deightons, of the Gourlay-Stephen interchangeable type.

The electric light installation is by W. C. Martin, of Glasgow. It consists of a Clarke & Chapman compound vertical open type

two-crank engine running at 350 revolutions and 100 pounds pressure. There are three dynamos, each capable of giving a current of 300 amperes at 65 volts pressure. The installation includes a Suez canal type search light, and arc lamps of 2,000 candlepower, capable of burning sixteen hours, electric radiators, etc., the total amounting to over five hundred 16-candlepower lights. In the public rooms and state-rooms electrically-driven punkahs are provided, for use in the tropics.

The refrigerating plant is placed in the starboard wing house on main deck alongside engine room. It is supplied by the Pulsometer Engineering Company, Nine Elms Iron Works, Reading. It is one of the usual type of ammonia compression machines made by this company. The chambers are cooled down on the brine system, and at the same time about one-half ton of ice is manufactured daily. The brine and circulating pumps are of the Karoome type. The capacity of the insulated chambers is equal to supplying 1,500 troops for thirty days.

The deck machinery is of the most approved type, the steering gear being particularly massive, the chains connecting the engine and quadrant being of 1⅞ inches diameter. The ground tackle of the *City of London* consists of patent stockless anchors, massive cable, and a powerful windlass fitted with large drum ends, and capable of carrying all the strain ever likely to be put on it.



THE BOILER PLANT OF THE CITY OF LONDON, ASSEMBLED IN THE BUILDERS' SHOP.

Comparative Fuel Tests.

An interesting service test of gasoline, kerosene and denatured alcohol was made in January in three similar automobiles of Maxwell pattern running from New York to Boston. The cars were standard touring cars of 1907 model, with a double opposed horizontal motor, the cylinders measuring 5 by 5 inches with an effective pressure of 58 pounds to the square inch. These motors are rated nominally from 16 to 20 horsepower, with gasoline. Each car carried identical equipment and passenger weights, the total weights being 2,270 pounds for the gasoline propelled car; 2,520 pounds for the kerosene car and 2,750 pounds for the car using alcohol. The carbureters were all of the standard type regularly used in Maxwell cars, no special devices being added in the case of the two cars not using gasoline. No adjustments of any kind were made during the trip, which covered a distance of 249 miles. The running time was 16 hours 20 minutes, giving an average speed 15.24 miles per hour.

Every ounce of fuel used on each of the cars was carefully noted by the observers, and these figures, used in connection with those of the weights and distance, give interesting data regarding the cost of operation for each fuel. The data may be tabulated as follows:

Car	Fuel Consumption	Cost per Gallon	Total Cost of Fuel per Trip	per Car-mile	per Ton*-mile
Gasoline	24¾ gal.	20 cents.	$4.95	1.988 cents.	1.752 cents.
Kerosene	33¾ "	13 "	4.39	1.792 "	1.397 "
Alcohol	40¾ "	37 "	15.08	6.055 "	4.404 "

*2,000 pounds.

It will be noted that the quantity of alcohol required was very much greater than with the other fuels, and as the cost per gallon was higher the showing is much less favorable than might have been anticipated. It must be borne in mind, however, that the engine was not particularly designed to use this fuel. It is evident that in a specially designed motor, using a longer stroke and much higher compression, the alcohol would make a far better showing. Many interesting observations were made as to the characteristics of alcohol under this use, it being observed that the motor apparently developed much more power on hills than did the other motors, because of the fact that there was a much higher mean effective pressure.

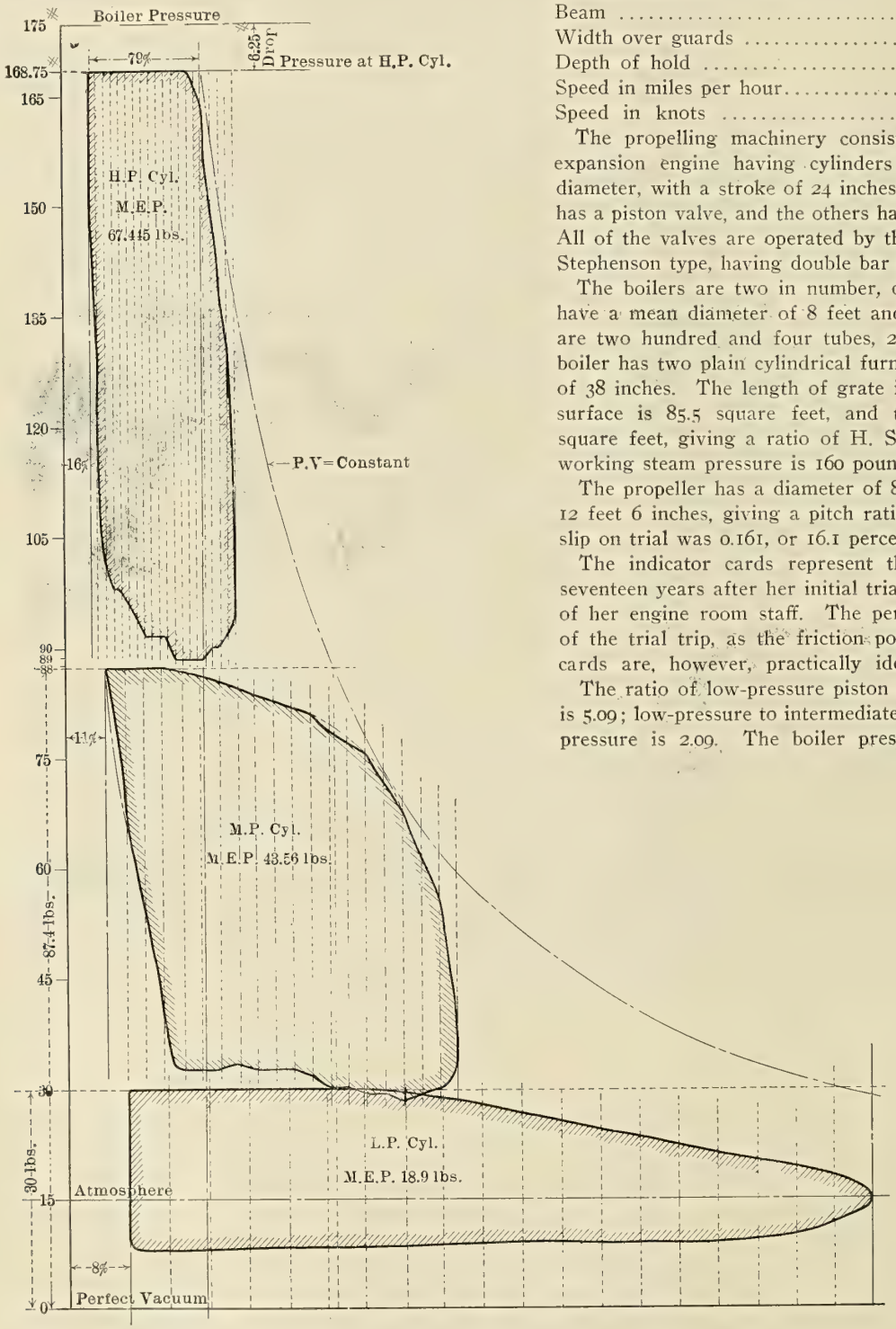
The chief object of the test, the lessons of which are as applicable to motor boats as to automobiles, was to demonstrate the relative values of the several fuels under conditions where it was not feasible to fit special devices or changes of equipment. The tests may be said to have developed the fact that carbureters as at present designed are capable of handling fuels of varying densities, and without radical alterations.

The Austrian government has enacted a law under which subsidies are to be paid to merchant ships for the next ten years, amounting to an average of above $1,000,000 (£205,000) per year. The same law grants a bonus for ships constructed, amounting to $8.12 (£1-13-5) for steamers for each ton weight of the body of the vessel; $2.84 (£0-11-8) for sailing vessels for each ton of the body; and $1.62 (£0-6-8) for each hundred kilograms (220.46 pounds) in the engines, boilers, piping and auxiliary engines of the vessel. These figures are paid only when 50 percent of the material of which the ship is built is home product; with a larger percentage the figures are correspondingly increased. The subsidy for shipbuilding is limited to $203,000 (£41,700) per year.

COMBINED INDICATOR CARDS.

BY CHARLES S. LINCH.

The combination of indicator cards is not only a very interesting procedure, but it presents, in a very vivid manner, faults that on the original card do not manifest themselves with such force as when seen in their respective positions, and affected with their proper clearances. It is not the purpose of the article to discuss the method of combining, as every designer should be thoroughly familiar with this. The cards shown are not from trial trips, but from every-day running.



COMBINED CARDS FROM THE ENGINE OF THE STEAMER CITY OF CHESTER.

CITY OF CHESTER.

The cards of Fig. 1 are from the Wilmington Steamboat Company's steamer *City of Chester*. This is a freight and passenger steamer plying between Philadelphia and Wilmington, and was built at the yard of the Harlan & Hollingsworth Company, Wilmington, Delaware, in 1888, from designs of the late Shields Wilson. The engine of this steamer was the first triple expansion engine built by the company. In summer season this boat makes three round trips daily, and has been in constant service since the above date, except for a couple of months in winter while undergoing general overhauling.

The particulars of this steamer are as follows:

Length between perpendiculars	185	feet 0 inches
Length over all	197	feet 6 inches
Beam	28	feet 0 inches
Width over guards	40	feet 0 inches
Depth of hold	9	feet 0 inches
Speed in miles per hour	19½	
Speed in knots	16.92	

The propelling machinery consists of a three-cylinder triple expansion engine having cylinders 18$\frac{11}{16}$. 27 and 42 inches in diameter, with a stroke of 24 inches. The high-pressure cylinder has a piston valve, and the others have double ported slide valves. All of the valves are operated by the ordinary valve gear of the Stephenson type, having double bar links.

The boilers are two in number, of the low gunboat type, and have a mean diameter of 8 feet and a length of 23 feet. There are two hundred and four tubes, 2½ inches in diameter. Each boiler has two plain cylindrical furnaces, with an inside diameter of 38 inches. The length of grate is 6 feet 9 inches. The grate surface is 85.5 square feet, and the heating surface is 3,289 square feet, giving a ratio of H. S. to G. S. of 38.5 to 1. The working steam pressure is 160 pounds gage.

The propeller has a diameter of 8 feet 6 inches, and a pitch of 12 feet 6 inches, giving a pitch ratio of 1.47; while the apparent slip on trial was 0.161, or 16.1 percent.

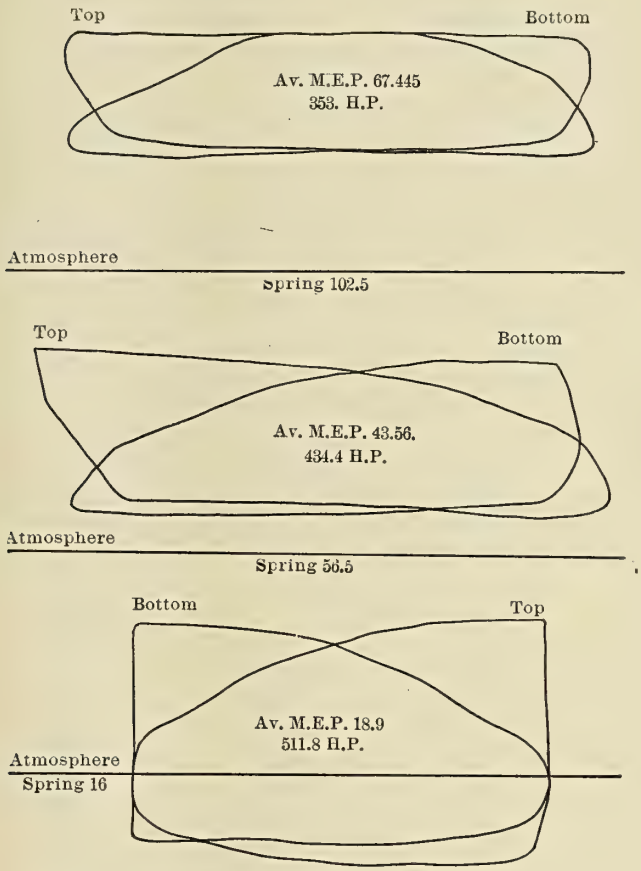
The indicator cards represent the performance of this boat seventeen years after her initial trial trip, and show the efficiency of her engine room staff. The performance is superior to that of the trial trip, as the friction power is greatly reduced. The cards are, however, practically identical.

The ratio of low-pressure piston displacement to high-pressure is 5.09; low-pressure to intermediate is 2.41; intermediate to high-pressure is 2.09. The boiler pressure of 175 pounds absolute suffered a drop of 6¼ pounds before reaching the high-pressure cylinder. The initial pressure was thus 168.75 pounds per square inch. Clearances in the three cylinders were respectively 16, 11 and 8 percent. The apparent cutoff in the high-pressure cylinder

was 79 percent. The actual cutoff, however, including clearance, was 95 ÷ 116, or 82 percent. The total ratio of expansion was $\frac{5.09}{0.82}$, 6.22, *i.e.*, $\frac{5.09}{0.82}$.

The mean effective pressure may be figured out theoretically from the formula $p_m = p_i \frac{(1 + \log. r)}{r} - p_b$; where p_m is the absolute mean pressure; p_i is the absolute initial pressure; p_b is the absolute back pressure and r is the absolute ratio of expansion.

In this case $p_i = 168.75$; $\frac{1 + \log. r}{r} = 0.4544$; and $p_b = 8.5$



INDICATOR CARDS FROM THE CITY OF CHESTER ENGINE.

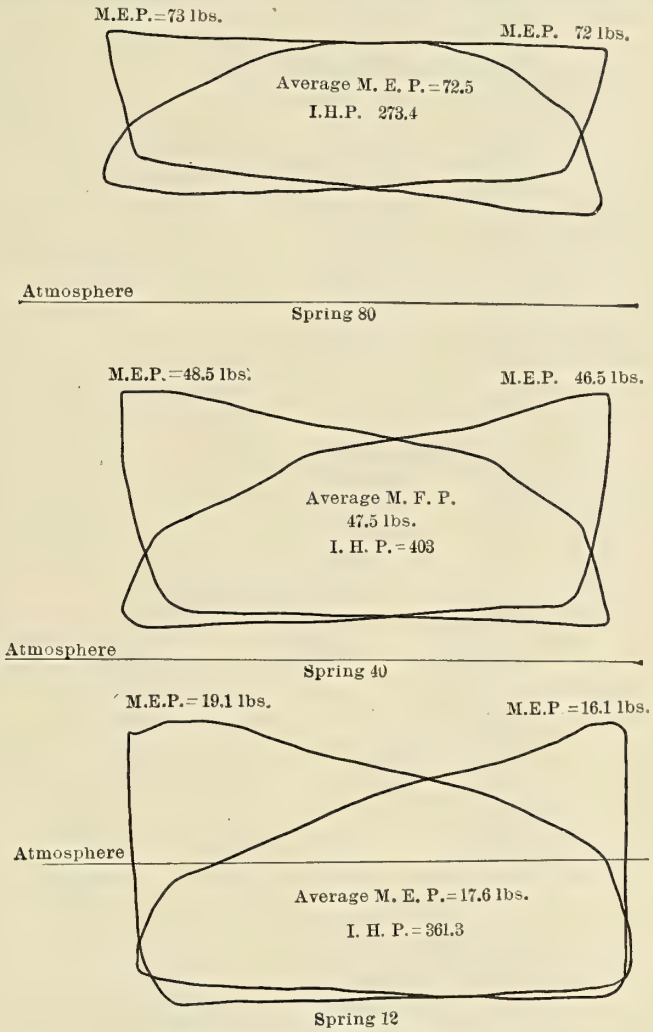
pounds per square inch; p_m therefore figures out as 68.2 pounds per square inch. The cards, however, show a mean effective pressure referred to the low-pressure cylinder of only 45 pounds per square inch. The ratio between these two is 0.66, which shows a designing or card factor of 66 percent.

The terminal pressure, due to the above-mentioned ratio of expansion, should be 27.5 pounds. As an actual fact, however, the terminal pressure was only 18.5 pounds per square inch. The first receiver pressure was 74 pounds; second receiver, 17 pounds; vacuum, 25 inches. With the throttle wide open the revolutions were 162 per minute. The cards show a total of 1,299.2 indicated horsepower.

As indicating the quality of the work on this engine, it may be stated that the steamer *Brandywine,* owned by the same company, was built by Harlan & Hollingsworth in 1885, and up to about one year ago was running with her original engine. Needing new boilers, they decided to reduce the diameter of the high-pressure cylinder, making the ratio of cylinder capacity one to four. The cylinder originally was of such high grade material, that when it was removed from the housings, the tool marks were still visible, and the packing of the piston rods had not been touched from the time they were put in, twenty years before. This engine was a remarkable type of compound engine. A peculiar characteristic shown in the indicator cards was manifested in her trial, in that the admission line was absolutely parallel with the atmospheric line, showing the total absence in wire-drawing effect.

MOHICAN.

The *Mohican* is a three-deck steel freighter of about 2,500 tons displacement, built in 1904 by the William Cramp & Sons Ship



INDICATOR CARDS FROM MOHICAN ENGINE.

& Engine Building Company, Philadelphia, Pa., for the Clyde Steamship Company. The principal dimensions are:

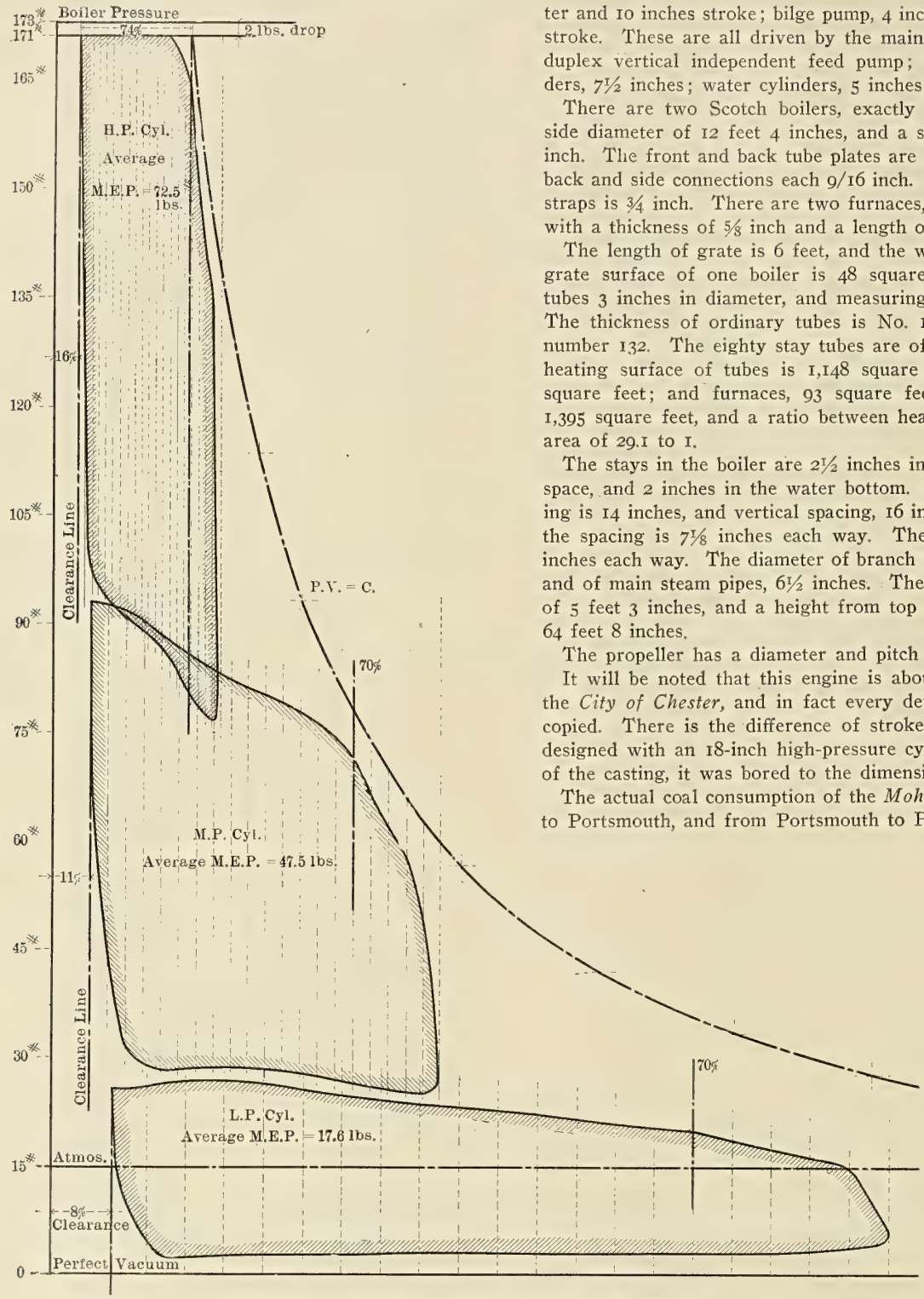
Length between perpendiculars	245 feet
Length over all	254 feet
Beam	40 feet
Depth	19 feet 6 inches

Draft, about 15 feet mean as an average.

Draft light, with engine room tanks and boiler full, and 225 tons coal in bunkers:

forward	6 feet 11 inches
aft	10 feet 11 inches
mean	8 feet 11 inches
Net tonnage	1,770
Gross tonnage	2,255

The ship is driven by one three-cylinder vertical, inverted direct-acting, triple expansion engine, having cylinders 18, 27 and 42 inches in diameter, with a common stroke of 30 inches. The high-pressure cylinder is fitted with a piston valve. The other two have double-ported slide valves. The travel of all valves is 5 inches.



COMBINED CARDS FROM THE ENGINE OF THE STEAMSHIP MOHICAN.

The diameter of crank shaft and pins is 8⅝ inches; length of all journals, 9½ inches; thickness of crank webs—high-pressure 5 inches, intermediate-pressure 6 inches, low-pressure 7 inches; width of all crank webs, 16½ inches; diameter of intermediate and tail shafts, 8¼ and 9¼ inches, respectively. The crank shaft is built up in one section.

The condenser forms part of the main engine, and contains 656 tubes of No. 17 B. W. G., ¾ inch in diameter, and having a length of 12 feet 1¼ inches. The cooling surface is 1,537 square feet. The air pump is driven from the crosshead of the intermediate-pressure cylinder, and has a diameter of 20 inches and stroke of 10 inches. The arrangements of feed pumps are the same as is usual with this type of engine, with 3½ inches diameter and 10 inches stroke; bilge pump, 4 inches diameter, 10 inches stroke. These are all driven by the main engine. There is one duplex vertical independent feed pump; diameter, steam cylinders, 7½ inches; water cylinders, 5 inches; stroke, 8 inches.

There are two Scotch boilers, exactly similar, having an inside diameter of 12 feet 4 inches, and a shell thickness of 31/32 inch. The front and back tube plates are each ⅝ inch thick; the back and side connections each 9/16 inch. The thickness of butt-straps is ¾ inch. There are two furnaces, 48 inches in diameter, with a thickness of ⅝ inch and a length of 7 feet 3½ inches.

The length of grate is 6 feet, and the width 4 feet. The total grate surface of one boiler is 48 square feet. There are 212 tubes 3 inches in diameter, and measuring 7 feet between heads. The thickness of ordinary tubes is No. 11 B. W. G., and they number 132. The eighty stay tubes are of No. 6 B. W. G. The heating surface of tubes is 1,148 square feet; connections, 154 square feet; and furnaces, 93 square feet; making a total of 1,395 square feet, and a ratio between heating surface and grate area of 29.1 to 1.

The stays in the boiler are 2½ inches in diameter in the steam space, and 2 inches in the water bottom. Their horizontal spacing is 14 inches, and vertical spacing, 16 inches. On flat surfaces the spacing is 7⅛ inches each way. The tubes are spaced 4½ inches each way. The diameter of branch steam pipes is 5 inches, and of main steam pipes, 6½ inches. The funnel has a diameter of 5 feet 3 inches, and a height from top of lower grate bars of 64 feet 8 inches.

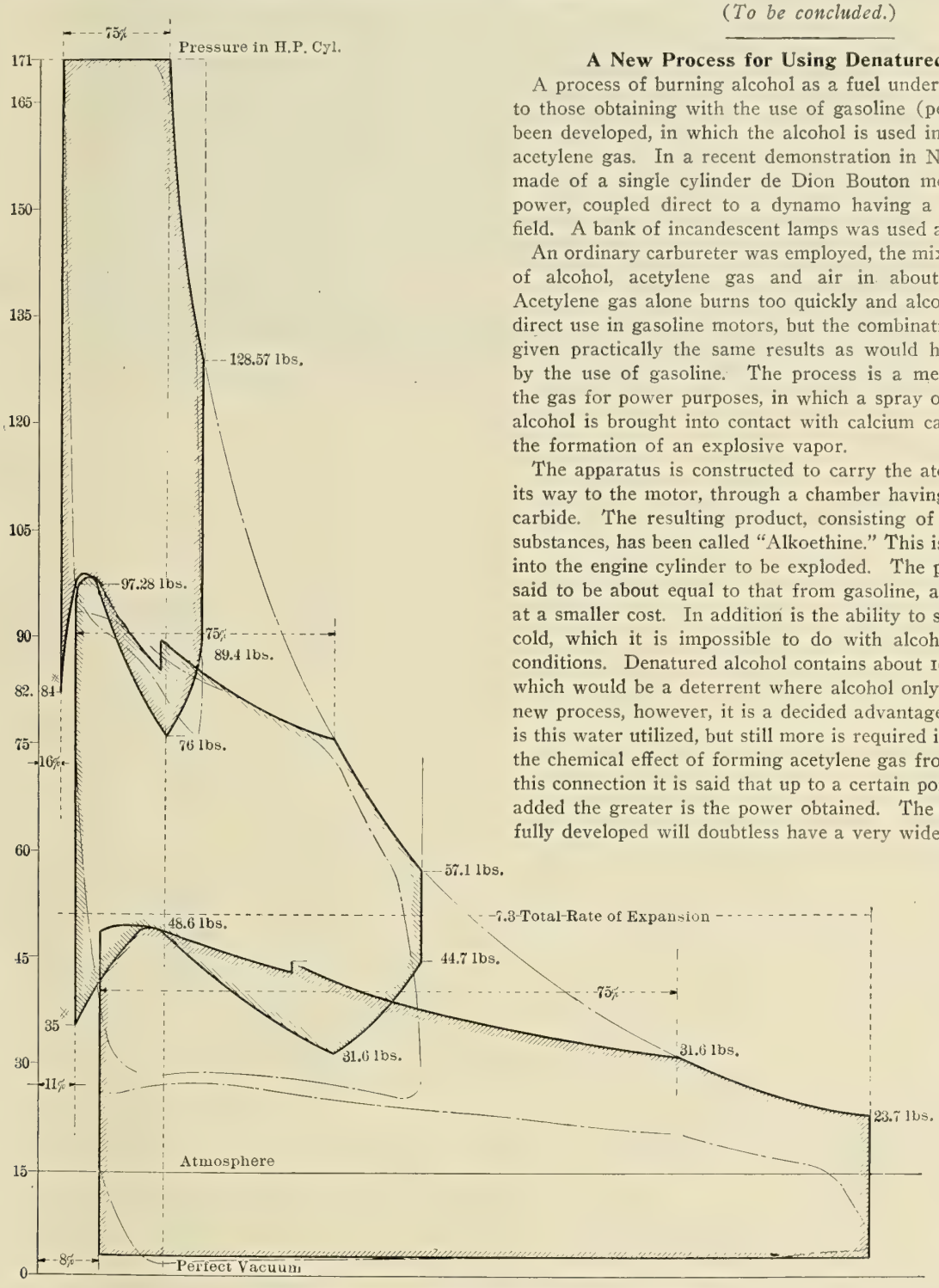
The propeller has a diameter and pitch of 12 feet 4 inches.

It will be noted that this engine is about the same as that of the *City of Chester*, and in fact every detail has evidently been copied. There is the difference of stroke, and the *Chester* was designed with an 18-inch high-pressure cylinder, but, on account of the casting, it was bored to the dimensions given.

The actual coal consumption of the *Mohican* from Philadelphia to Portsmouth, and from Portsmouth to Philadelphia, is 18 tons. This does not include the coal used in running from Portsmouth to Norfolk and from Norfolk to Newport News. This line does not have lighters, but moves the steamer from wharf to wharf, discharging cargo, and after time and register are taken at Portsmouth, no attention is paid to it, as the runs are very short. This 18 tons, however, cannot be charged to main engines alone. The steam steering gear and the circulating engine, besides the sanitary pumps, must be deducted, before the consumption for main engine can be fixed. There is only natural draft, no forced draft apparatus being fitted.

The ratio of low-pressure piston displacement to high-pressure is 5.44; low-pressure to intermediate cylinder, 2.41; and intermediate to high-pressure cylinder, 2.25. The intial steam pressure

was 171 pounds absolute; first receiver pressure, 95 pounds; second receiver pressure, 26 pounds. With 97.8 revolutions per minute, the total indicated horsepower was 1,037.7. The actual cutoff was (74 + 16) ÷ 116, or 77.6 percent. The total ratio of



IDEAL DIAGRAM OF COMBINED CARDS FROM ENGINE OF MOHICAN.

expansion was 7.02, *i.e.* $\frac{5.44}{0.776}$. The mean effective pressure referred to the low-pressure cylinder, by computation, was 68.85 pounds. The cards, however, showed a mean effective pressure of only 50.62 pounds, thus giving a card factor of 73.6 percent.

An ideal diagram is presented for the *Mohican*, in which the initial pressure of 171 pounds absolute is carried intact to an apparent cutoff of 75 percent (actual, 78.5 percent). The same ratio of cutoff is used in each of the other cylinders. This will make an interesting comparison with the actual combined cards, drawn from indicator cards taken in service. The high-pressure crank was leading, followed by the intermediate-pressure and then the low-pressure. There was no compression in the low-pressure cylinder.

(To be concluded.)

A New Process for Using Denatured Alcohol.

A process of burning alcohol as a fuel under conditions similar to those obtaining with the use of gasoline (petrol) has recently been developed, in which the alcohol is used in combination with acetylene gas. In a recent demonstration in New York, use was made of a single cylinder de Dion Bouton motor of 3½ horsepower, coupled direct to a dynamo having a separately excited field. A bank of incandescent lamps was used as resistance.

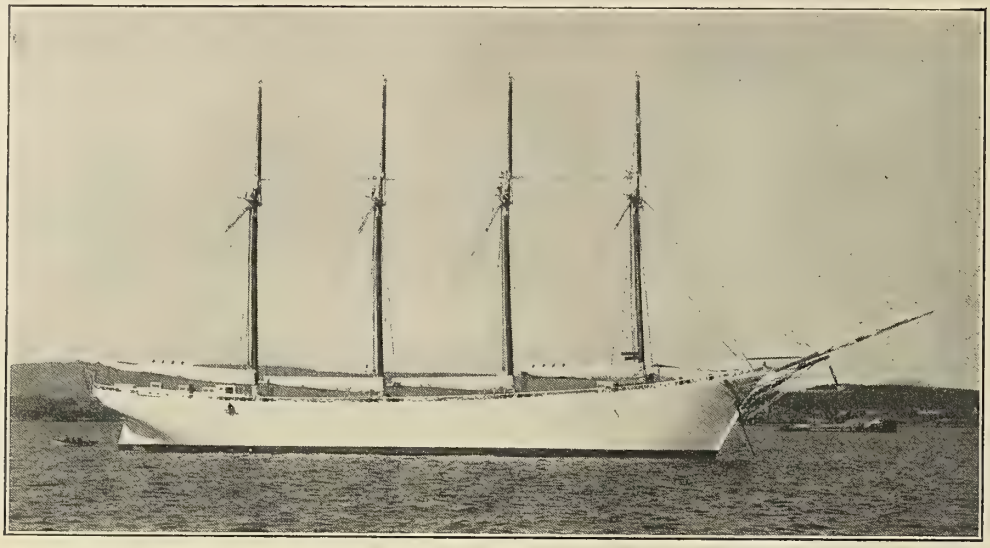
An ordinary carbureter was employed, the mixture being formed of alcohol, acetylene gas and air in about equal quantities. Acetylene gas alone burns too quickly and alcohol too slowly for direct use in gasoline motors, but the combination is said to have given practically the same results as would have been obtained by the use of gasoline. The process is a method of producing the gas for power purposes, in which a spray of atomized diluted alcohol is brought into contact with calcium carbide, resulting in the formation of an explosive vapor.

The apparatus is constructed to carry the atomized alcohol, on its way to the motor, through a chamber having a bed of calcium carbide. The resulting product, consisting of the three gaseous substances, has been called "Alkoethine." This is passed by suction into the engine cylinder to be exploded. The power developed is said to be about equal to that from gasoline, and to be produced at a smaller cost. In addition is the ability to start a motor while cold, which it is impossible to do with alcohol under ordinary conditions. Denatured alcohol contains about 10 percent of water, which would be a deterrent where alcohol only was used. In the new process, however, it is a decided advantage, because not only is this water utilized, but still more is required in order to produce the chemical effect of forming acetylene gas from the carbide. In this connection it is said that up to a certain point the more water added the greater is the power obtained. The new process when fully developed will doubtless have a very wide field of operation.

The steam fleet of Hamburg has shown a decided increase during the past year, as represented below:

Jan. 1, 1906..... 634 ships 1,711,839 gross tons 1,067,861 net tons.
Jan. 1, 1907..... 662 ships 1,874,149 gross tons 1,167,523 net tons.

This represents an increase of 4.4 percent in number of ships; 9.5 percent in gross tonnage and 9.4 percent in net tonnage. The average size of ship has increased from 2,700 gross and 1,684 net to 2,831 gross and 1,763 net tons. The sailing vessels increased during the year from 430 to 457, but there was a decrease of 6,631 in net tonnage.



AUXILIARY SCHOONER NORTHLAND, FITTED WITH A DOUBLE ACTING GAS ENGINE. (Photograph, N. L. Stebbins.)

THE AUXILIARY COASTING SCHOONER NORTHLAND.

This large schooner, built by the Cobb-Butler Company, of Rockland, Me., in 1906, has an auxiliary engine in the shape of a 500-horsepower six-cylinder double acting reversing gasoline motor, built by the Standard Motor Construction Company, of Jersey City. The vessel has a length of 246 feet on the waterline and 270 feet on deck; a beam of 44 feet 1 inch; a depth of 22 feet; and a draft of 15 feet. Her net tonnage is 1,568, and gross, 2,047; and she is owned by the Northern Maine Power Packet Company. She is said to be the largest motor schooner in the world.

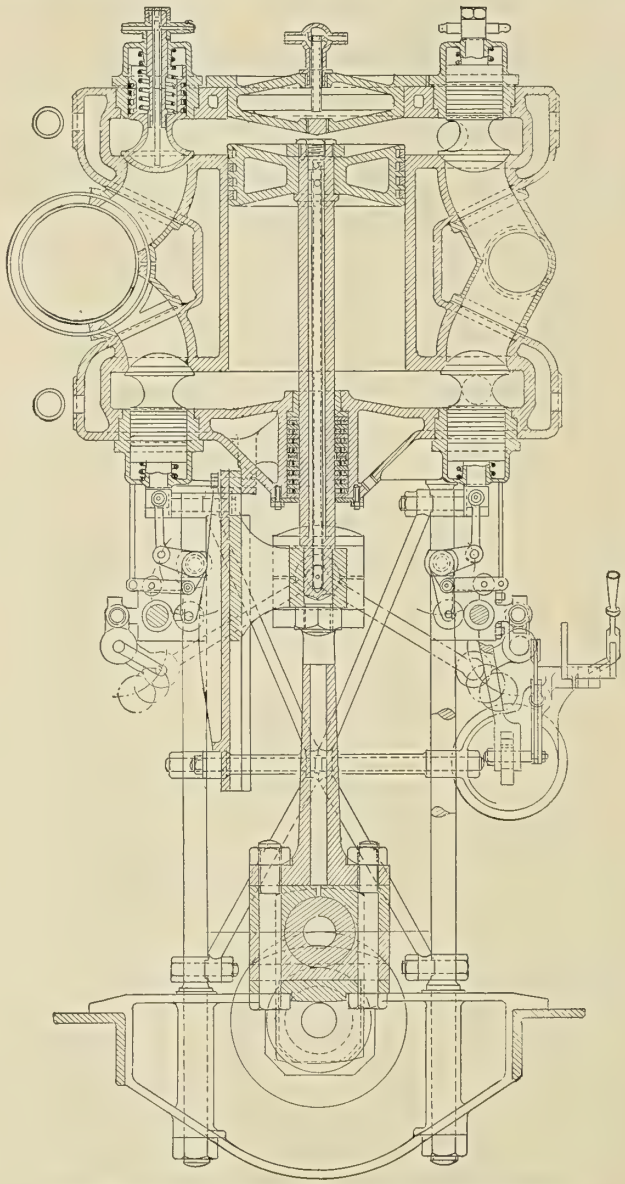
Her engine drives a propeller, 7 feet in diameter, and of 4 feet pitch (pitch ratio, 0.571), the engine room being large and roomy, and located near the stern. The accompanying sketch for a previous vessel of the same general type shows the situation.

At the sides of the engine room are two gasoline tanks with a capacity of 6,000 gallons. The speed of the vessel is from 5 to 6 knots when using engine power alone. There are two small engines for generating electricity, these being located in the main engine room. The electrical power is used for operating elevators, facilitating the handling of cargo; and they also furnish electric lighting throughout the schooner, and operate a searchlight, the two latter features being decided innovations in coastwise schooners.

The vessel has a frame of hard wood and hackmatack, with planking and ceiling of Georgia yellow pine. The forward deck house, built of North Carolina pine, provides quarters for the steam plant for operating sails, anchors and pumps, the galley, forecastle and engineers' room. The after house, handsomely finished in hard wood, has accommodations for the captain and officers.

The schooner has five hatches, instead of the usual three for vessels of her size. The extra hatches, which have the elevator service, are used for handling the product of the mills of the Great Northern Paper Company, which she brings to New York; carrying coal and general cargo in return. Each elevator has a lifting capacity of 5,500 pounds. The spars are of Oregon pine, the lower masts being each 111 feet, and the top masts 56 feet, in length. The spread of canvas, which is complete, aggregates 9,000 square yards. There are two Baldt stockless anchors of 7,000 pounds carried, in addition to a stream anchor of 900 pounds and a kedge of 500 pounds.

The engine, of which we present illustrations, is of the same general type as the 300-horsepower engine of the motor yacht *Standard*, which is said to hold the world's official record for the mile and the kilometer. The time of the *Standard* over a nautical mile was 2 minutes 10 seconds, and for the kilometer 1 minute 7 seconds. The former figures out at 27.69 knots (31.89

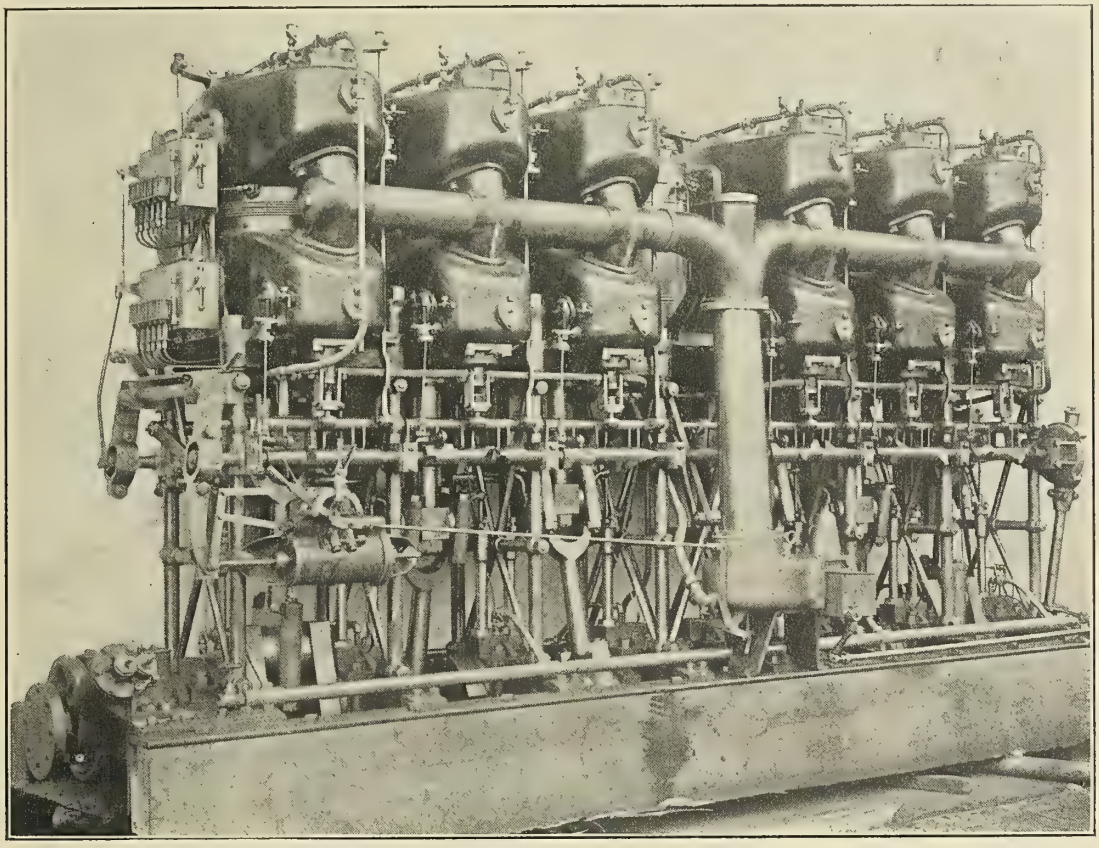


SECTION THROUGH CYLINDER OF DOUBLE ACTING GAS ENGINE.

statute miles per hour). The latter is 28.99 knots (33.39 statute miles per hour). The Admiralty mean of six runs, on the mile with and against the tide, showed an average of 25.45 knots, or 29.503 statute miles per hour.

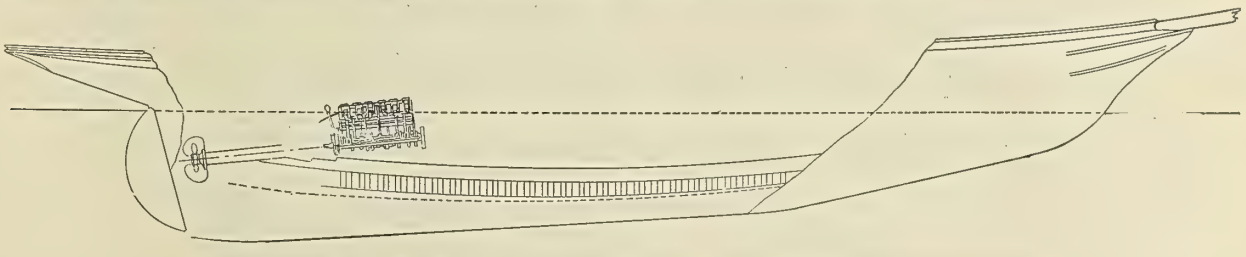
base is 30 inches; while the greatest width over cylinders is 34 inches.

The illustrations of the new motor, as shown, serve to confirm the impression of a torpedo boat engine, as the same



500-HORSEPOWER DOUBLE ACTING STANDARD ENGINE IN THE SCHOONER NORTHLAND.

These engines have in reality twelve working cylinders, figured from the point of view of the usual construction of gas engines. The result is an extremely smooth and quiet running machine, well balanced, and with the valves so arranged that practically the only vibration noticeable is occasioned by the force feed pumps, which give individual feed to every cylinder and bearing. Ignition is of the make-and-break type, while pistons and piston rods are water-cooled, and water flows freely also through the valves. A very noticeable advantage of the double-acting engine is the practical impossibility of any leakage of gas into the engine room, because the piston, instead of being open to the atmosphere, type of supports, connecting rods, cross heads and guides are here used that one is accustomed to in the other kind of engine. The double acting principle necessitates some radical changes from the usual marine gasoline motor design, such as water-cooling the pistons, connecting rods, valves and other parts exposed to the intense heat produced in cylinders of such large volume. Inlet and exhaust valves are located on the opposite sides of the head, as is customary with many automobile and marine engine builders. The upper and lower ends of the cylinders are alike, with a regular marine engine piston and connecting rod.

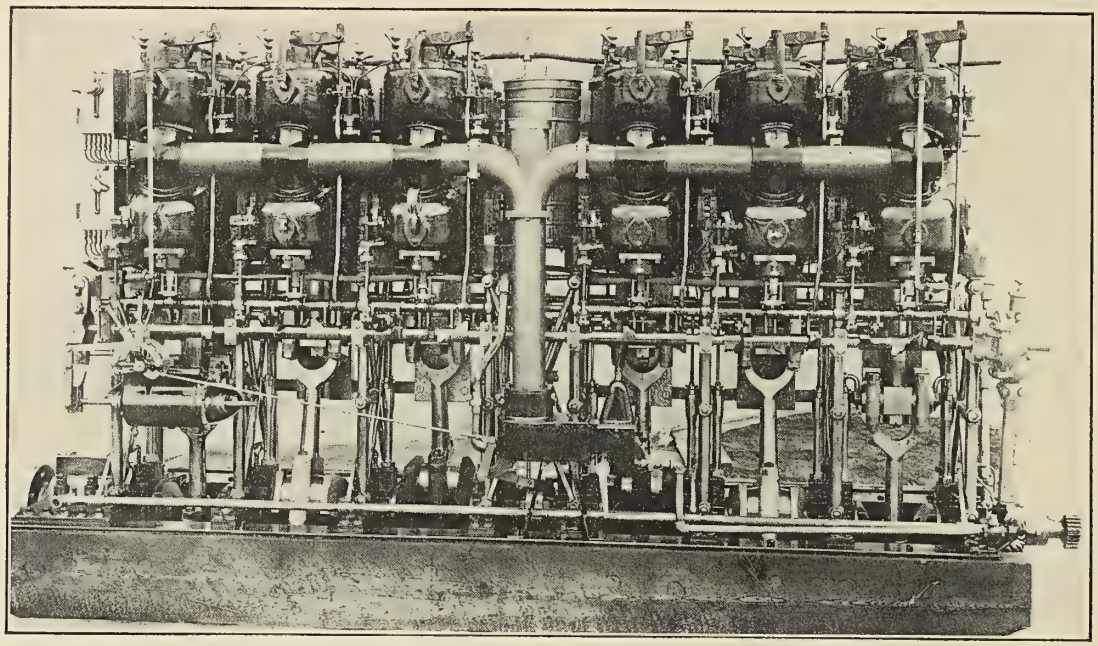


SKETCH ILLUSTRATING THE LOCATION OF THE GASOLINE ENGINE IN AN AUXILIARY SCHOONER.

as in most types of single-acting engine, is operated from a piston rod running through a metallic stuffing box. The operation of the valve shaft is obtained, as in a large steam engine, by using a small air cylinder; this is also used for turning the engine over.

The bore and stroke of the *Standard's* engine are each 10 inches; the weight is 7,500 pounds, or 25 pounds per horsepower; the length over cylinders is 8 feet 3 inches; length over all, 10 feet 4 inches; the total height is 5 feet 6½ inches, of which 4 feet 9½ inches come above the center of the shaft; the width of the

The method of getting the gas into the cylinders is very neatly and simply worked out, as is shown in the inlet side. One branch pipe leads up to the cylinders from the center, and then runs to each end of three cylinders. The spark and throttle control levers are mounted on top of the air cylinder, which controls the travel of the cam shaft. One essential point of difference between the ordinary motor and this motor is that the valves are pulled up instead of being pushed up, and that they are balanced and water-cooled by a stream of water which

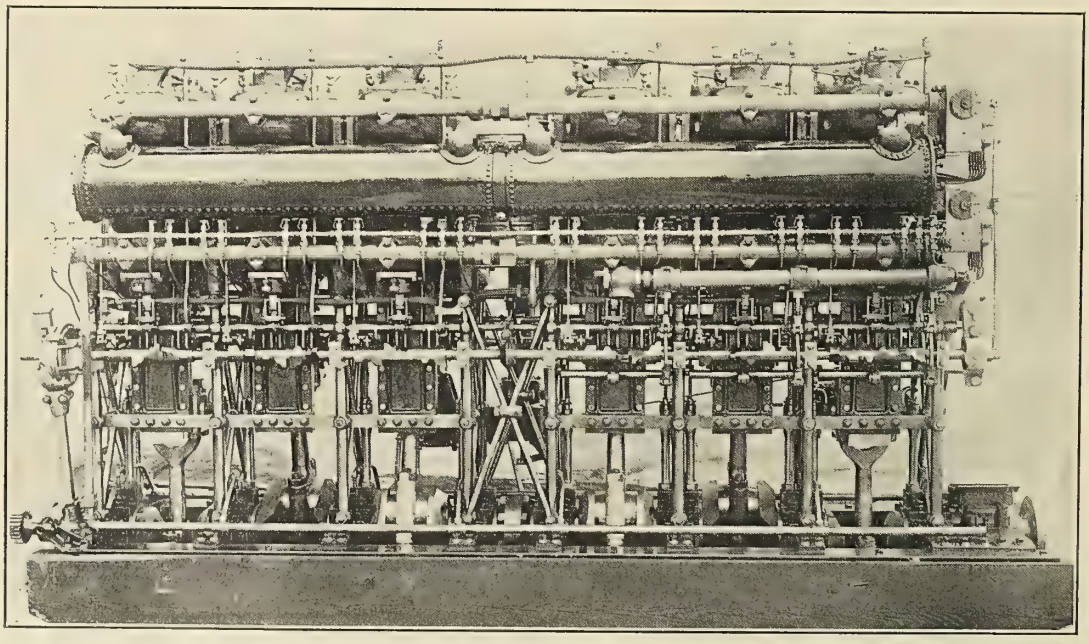


INLET SIDE OF THE 300-HORSEPOWER DOUBLE ACTING ENGINE OF THE STANDARD.

flows through them constantly. This type of valve has been adopted by the Standard Company for all their large type of motors, and has been found to work exceedingly well. On this side, also, are located the trips which operate the sparkers for all cylinders.

Similarly, the other illustration shows the exhaust side of the motor, with valves operated from a cam shaft which is a duplicate of that upon the inlet side. These valves are also water-cooled and discharge directly into a large water-cooled exhaust box, from which the gases are led to the muffler. The oil feeds are directly under the exhaust box, with individual leads to distribute the oil to the different bearings. Directly below and behind this are shown the air inlets to the cylinders for starting. In a large motor of this kind the problem of properly cooling it and keeping it well oiled is a difficult one, and the working out of the systems by which these results are accomplished is more complicated than it would be for a small motor, but the owner of a motor of this size could hardly expect to operate his own engine, and in reality the successful working of the motor does not demand a higher order of skill than is to be expected from the engineer of an ordinary triple-expansion steam engine. While the appearance of the motor is complicated, this complication is more apparent than real. Every function of the motor has been carefully thought out and provision made to assure its proper working under all conditions. All Standard motors of large power have been made self-starting and reversing, the same principles which have been found so successful being employed in this latest type; but in the double-acting type both the inlet and exhaust valves are mechanically operated, as against the exhaust valves only in the other self-starting and reversing motors. Another important difference is that in this type all the cylinders are cast separately, and the motor is really two three-cylinder motors coupled together for purposes of economy in construction and replacement, should such be necessary.

The self-starting is accomplished by compressed air being



EXHAUST SIDE OF THE 300-HORSEPOWER DOUBLE ACTING ENGINE OF THE STANDARD.

admitted on one end of three cylinders, which turn the motor by a special set of cams until it takes up its cycle upon gasoline. The cam shafts which actuate all valves are so made as to move longitudinally on their axes, and to bring appropriate cams into action for either direction. As the physical labor required to perform this operation would be considerable in a motor of this size, an air cylinder is added to perform this work, so that the only manual labor in connection with running the motor is that in operating the two handles shown in the left hand end of the inlet side illustration. One lever controls the position of the cams, whether for ahead or astern, while the other controls the spark and throttle. In this motor the necessity of a flywheel is entirely done away with, and operating at any speed, from maximum to minimum, little or no vibration is felt. The motor is mounted upon a base of angle iron with castings for each individual bearing, and has the usual marine collar thrust bearing.

Incidents and Accidents on a Long Tow.

The month of February, '92, found me in Antwerp, Belgium, out of a billet, as the ship in which I was "chief" had been laid up in that port several months before. My elation, therefore, will be well understood, when I was notified by a former superintendent of mine that there was a position open for me to take a ship out to the Congo for river service, for I knew that the contract would tide me over the winter, at any rate. I at once applied for the position, but was advised to go and see the ship first, as several others had backed out when they saw the vessel. I then went up to Hoboken, above Antwerp, and found to my astonishment that she was a towboat of 70 feet by 11 feet 6 inches and a draft of 6 feet 6 inches. She had one Scotch boiler, with one furnace, carrying 90 pounds pressure, and compound engines having cylinders 12 and 22 inches by 2 feet stroke. As mine was a case of "needs must where necessity drives," I decided to take the risk. Fortunately my nerves were in the best condition, for, as it turned out, I had taken a job which required them to be so.

The preliminaries with regard to wages, etc., all being satisfactorily settled, I went up to inspect the ship, and found all in good condition, as the vessel was almost new and had apparently been little used. Although it was but February when I joined, it was May before we sailed, the delay being caused, I believe, by the difficulty in getting any one to take the insurance risks. In the meantime I found out that our risk was greater than I had at first understood, as we had to tow a barge which served as coal supply depot, and carried about 100 tons. My ship burned about 3 tons a day, had 8 tons bunker capacity, and carried about 20 tons on deck, so that it will be easily seen that the barge was a necessity for the long voyage. We sailed slowly down the river, passed the big liners alongside the quays, and waved farewell to our friends on the banks and on the ships, many of whom doubtless thought we were taking on risks amounting almost to foolhardiness. We made our way down the Scheldt and out into the North Sea, with orders to proceed to Vigo, Spain, and there to await the arrival of the barge, as the underwriters would not allow us to tow her across the Bay of Biscay.

Our passage across the North Sea was successful enough, steaming about 10 knots, and we might have made more, but having to clean our fire about every six hours, I had to link in the engines while doing this, to keep the steam at all reasonably high during the operation. However, "experience teaches," and I got on much better afterwards by cleaning one-half of the fire at a time, and keeping the other half rather heavy. We passed Dover with smooth sea, but in a couple of hours it began to blow hard, the sea rose and we shipped one sea down the engine room, which filled it to a depth of three feet and drowned out the fire. Fortunately for us then, I had the bilge ejector in good order, and with the steam in the boiler I got the water out and kept the engines moving until I got the fire going again. The captain in the meantime decided to run for Portland to get things squared up, and we lay there for three days, until the weather moderated, when we again took our departure for the dreaded Bay of Biscay, the crossing of which was expected to form the crucial test of our fitness for the long run to the Congo. In this case, the Bay belied its reputation, as the sea was like a mill pond, and we reached Vigo without any incident worthy of mention, and awaited the arrival of the lighter, which came in nine days later.

The following day we left Vigo and headed for Las Palmas, in the Canary Islands. We were towing the lighter with 160 fathoms of line out, and were making about 5 knots, with a strong following wind and sea, the barge having all her sails set, and all apparently going well, when the captain remarked that the men in charge of the barge were evidently having a jubilee, as she was sheering from side to side at her own sweet will, and dragging our stern under water at every sheer. This sort of thing went on until the fourth day, when the crew of the barge signalled for us to take them off, as they were sinking. But our skipper decided that as they had evidently strained the barge through their unseamanlike conduct, they ought to suffer for it, so he sent up the old sailing ship signal, "Pump or sink, you ——."

There was a change in the bargemen's demeanor when they saw how matters stood, and they would pump frantically for a while, and then dance around excitedly, imploring us to take them off, but our Nova Scotia skipper's blood was up, and he gave orders to have a hatchet ready to cut the towrope, and repeated his threat, "Pump or sink." From early dawn to dewy eve they were to be seen pumping in gangs until they had the water under control. About this time we noticed a heavy vibration throughout the ship, and the engines immediately speeded up, so I came to the conclusion that we had lost some of our propeller blades. Upon our arrival at Las Palmas I examined the propeller, and found that there was only three-quarters of a blade left, as the other 2¼ had broken off.

We put the vessel on the beach at high water, and I decided to fit the spare propeller, as we expected to find it high and dry at low water, but unfortunately the shaft was only one inch out of the water. However, I set to work to get the broken propeller off, which I did after a great deal of trouble and by using the spare propeller shaft for a ram. To get the propeller clear of the shaft, I found that I would have to lift the crank shaft clear of the bearings, to enable me to draw the tail end in. After a considerable amount of labor, owing to the bad fit of the spare propeller, and working up to the waist in water all one day and part of the next, I succeeded in completing the job satisfactorily.

Our unworthy captain of the lighter then wanted to know when we were going to fix his vessel, and of course he was immediately told to do it himself. This he refused to do, and said he would prefer to go home as he "had had quite enough of it." We thought he referred to gin, so agreed with him there, but he explained that he had referred to the responsibility of being master of a leaking barge. Then our skipper and I had a consultation, and we agreed to do what we could for him. We ran the barge on the beach at the next high water, and at low water we dug a trench underneath it, but unfortunately, as soon as it was dug it filled up again with water. The captain, on trying to get under, had a narrow escape. He was of rather stout build, and got himself jammed in. The water rose around him until only his nose was above water, and, lying there on his back, the case looked serious for him. However, we managed to haul him out by passing a rope under his arms, and things remained in this state for some time, while we discussed the ways and means of getting at the leak. We decided to take all the coal from around the mast and examine the stool, where we suspected the leak would be, but after we had done this we found that we could do nothing there, as the stool was right over the leak. The only thing left open then was to get under the

lighter. It was decided that I should have a try, as I was not so big a man as our noble skipper; so with a rope made fast around my feet, and another under my arms, I lay on my back and was drawn under the lighter, with about three inches clearance between my nose and the bottom. The water was all around my body, head and face, with my mouth and nostrils awash. As it was impossible to see, I had to feel with my hands; and sure enough, I located eleven small rivets out immediately under the mast. I then signalled to be drawn out, so that I might make some wooden plugs to drive in the holes. After making them, I was pulled under again and hammered in the plugs, and to make assurance doubly sure, we put two casks of cement around the stool. I for one was very glad when the job was completed, and she was found tight when she floated at next high water.

We then got everything ready again for our next step on the long journey, and next day we headed for Monrovia, the capital of Liberia. Our voyage there was very moderate with regard to weather, but I had considerable trouble with the engines. A few days after leaving the Canaries, one of the main bearings became hot, and upon examination I found that a piece of metal about 3½ inches long by ½ inch deep had come out of the journal, so I decided to fit the spare shaft. This, fortunately, had all the keyways cut, so that it was simply a matter of stripping the old shaft and refitting the gear to the new one. This occupied us the greater part of one day, owing to the awful rolling of the little craft.

Taking advantage of the stoppage, the people on deck had decided to fill our bunkers from the barge. As we were just off Turtle Island at the time, and in shallow water, we were enabled to anchor, and with a rope fast between towboat and lighter, we were able to draw a small boat full of coal from the lighter several times, until we had sufficient; but it was dreary, wet work, the men in the boat being soaked through continually with the spray. This operation had to be repeated on the passage, under even worse conditions, as we were then in water too deep to anchor in.

However, we again proceeded, and had not gone far when a severe shock was felt, and the engine stopped immediately. I at once jumped down below, and found that both top end bolts had broken in the low-pressure crosshead, and as good luck would have it, one of them had bent and jammed the engine, thus preventing further damage. Having the necessary spare bolts, I soon fitted them in, and we once more got under way. In due course we arrived at Monrovia, all safe, but almost tired out through lack of sleep and poor food, for we had not had half a dozen decent meals the whole passage, through the galley fire's being out by the seas we shipped in the calmest weather.

After taking in provisions here, we again proceeded, this time for the Congo, and glad I was to know that the long passage was drawing to a close. Between Monrovia and the Congo I had to fit new saddle-blocks to both valve-gears, and, with this exception, we arrived without incident at Banana, after a passage of sixty-one days. We stopped at Banana, where I had a good night's rest, and the next morning we proceeded up the river for Matadi, but soon found that we could not tow the lighter against the strong current that runs in the Congo.

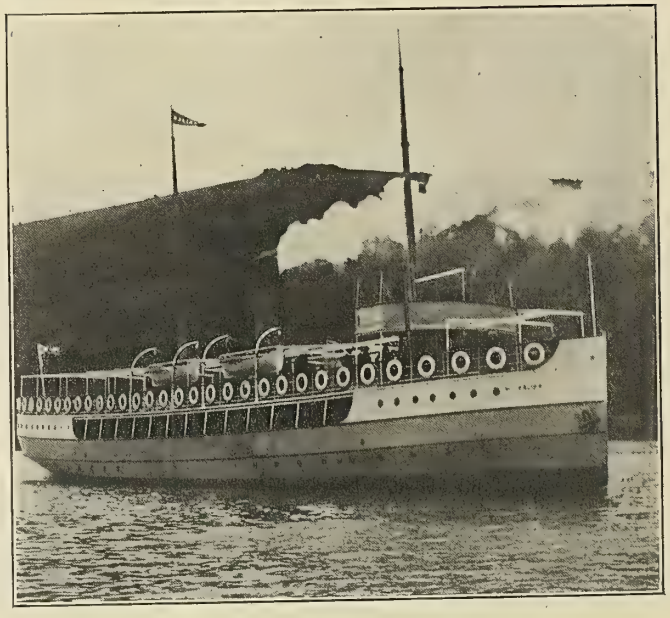
Now it was "up to me" to get the ship up the river, so I altered the safety valve compression nuts until I got the boiler to blow at 115 pounds, 25 pounds more than the working pressure, as I knew that the boiler was in first-class condition, and would easily stand it. Then we steamed slowly up in style, galloping along at about four knots. After trying to shift the river bank with our bow once on the way up, we arrived in Boma, the capital, where we were to give the vessel over to those in authority. They asked us to oblige them by taking her to Matadi, as all the crew who would now take charge of the vessel were there. We stayed in Boma for the night, and next day proceeded to Matadi, where we duly arrived in a few hours, thus ending a contract which I would not take on again at any price. E. C. A.

LIGHT DRAFT SINGLE SCREW PASSENGER STEAMER.

At the shipbuilding and engineering works of Philip & Son, Limited, Dartmouth, South Devon, there has been completed the nicely modeled single screw steel passenger steamer *Kalika*, built in accordance with the requirements of the Board of Trade and under their survey, to the order of Hajee Ahmed Hassum, and intended for service in and around Bombay, India.

The principal dimensions are as follows:

Length over all	157 ft. 0 in.
Length between perpendiculars	150 ft. 0 in.
Beam molded	26 ft. 0 in.
Depth molded amidships to main deck	9 ft. 3 in.
Depth molded amidships to upper deck	16 ft. 6 in.
Draft of water aft, with steam up, tanks and bunkers full	7 ft. 6 in.
Draft of water forward, with steam up, tanks and bunkers full	5 ft. 6 in.
Draft of water mean, with steam up, tanks and bunkers full	6 ft. 6 in.
Displacement, corresponding to the above draft	315 tons
Coefficient of fineness of displacement	0.47
Area of load water plane	2,820 sq. ft.
Coefficient of load water plane	0.74
Area of immersed midship section	128 sq. ft.
Coefficient of midship section	0.82
Area of wetted surface	3,700 sq. ft.
Tons per inch of immersion at load waterline	6.7
Capacity of coal bunkers	40 tons
Capacity of fresh water tanks	22 tons



THE KALIKA LEAVING DARTMOUTH HARBOR FOR TRIAL TRIP.

HULL.

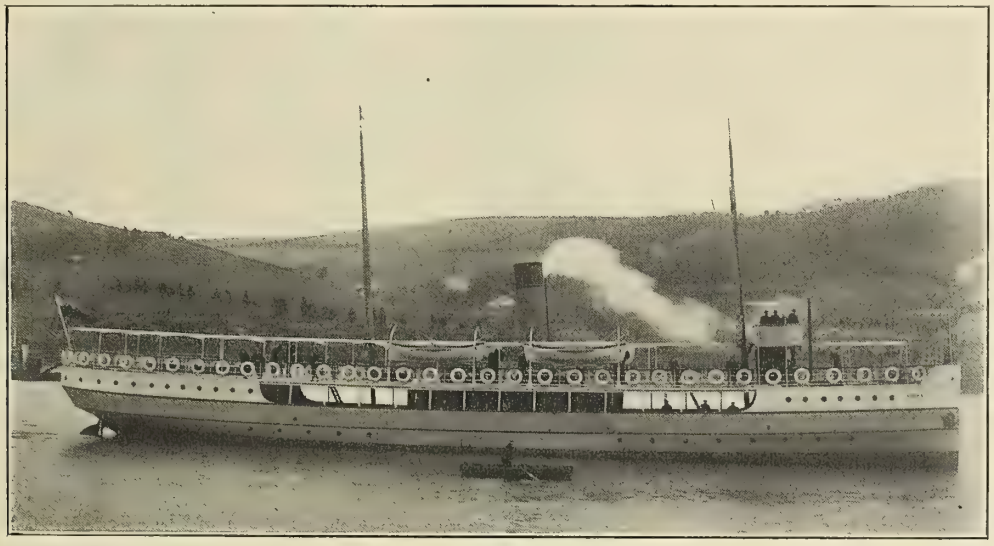
The keel is of the vertical bar type, of hammered scrap iron, 6½ inches deep by 1¼ inches thick. The stem is of the same material, and measures 6 by 1¼ inches. The stern frame and rudder post are of the same material and measure 6 by 2½ inches. Stops for the rudder are forged on to the rudder post, limiting the angle of the rudder when hard over to 45 degrees, on each side of the center line. The rudder is of the single plate type, the plate being of steel 25 pounds per square foot, securely riveted to the arms, which are forged solid with the frame. This is of hammered iron, the head being 4 inches diameter. The pintles are of the "renewable" type having a diameter of 2½ inches, and working in gunmetal bushed eyes, forged solid to the rudder post.

The transverse frames are spaced throughout 21 inches

DECK VIEW OF KALIKA, LOOKING FORWARD.

formed of angle steel 5 by 3 inches by 8/20 inch, and each extends from the stem to the transom frame. To the latter they are each connected by strong brackets, while at the stem they are well secured by strong plate breasthooks.

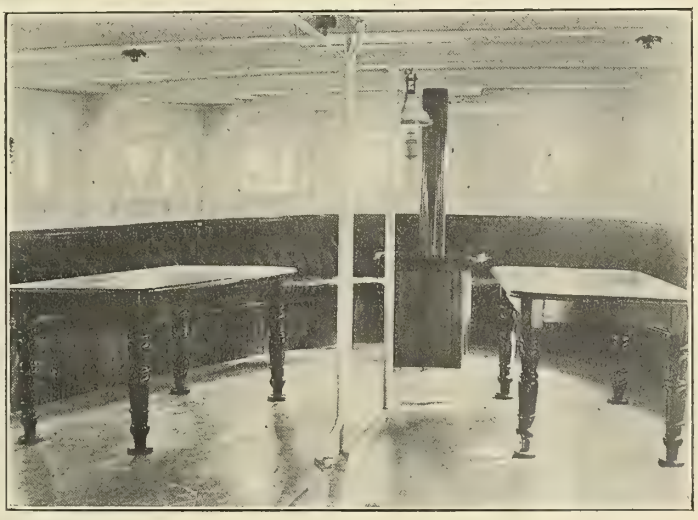
The main deck beams are of angle steel 4½ by 2½ inches by 6/20 inch, fitted on every frame, to which they are connected by 12-pound gusset plates 15 by 15 inches. The camber is 7 inches in the full breadth. The main deck stringer plates are 24 inches by 12 pounds for half length amidships, tapering to 18 inches by 10 pounds at the ends. They are fitted close to the sheerstrake plating, to which they are connected on the upper side by continuous angle bars 3 by 3 inches by 6/20 inch. Another continuous angle, of the same size, is fitted 10 inches from this one, so as to form a gutter waterway and a stop for the wood deck. The whole of the main deck beams are plated over with steel, under the wood deck, the two center line strakes being of 10 pounds, and the remainder of 8-pound material. The main deck is of pitch pine 4½ inches wide by 2½ inches thick, laid in long lengths, and well fastened to the beams and plating by ½-inch diameter, cheese head square necked galvanized bolts and nuts.



THE SCREW STEAMER KALIKA, FOR SERVICE AROUND BOMBAY, INDIA.

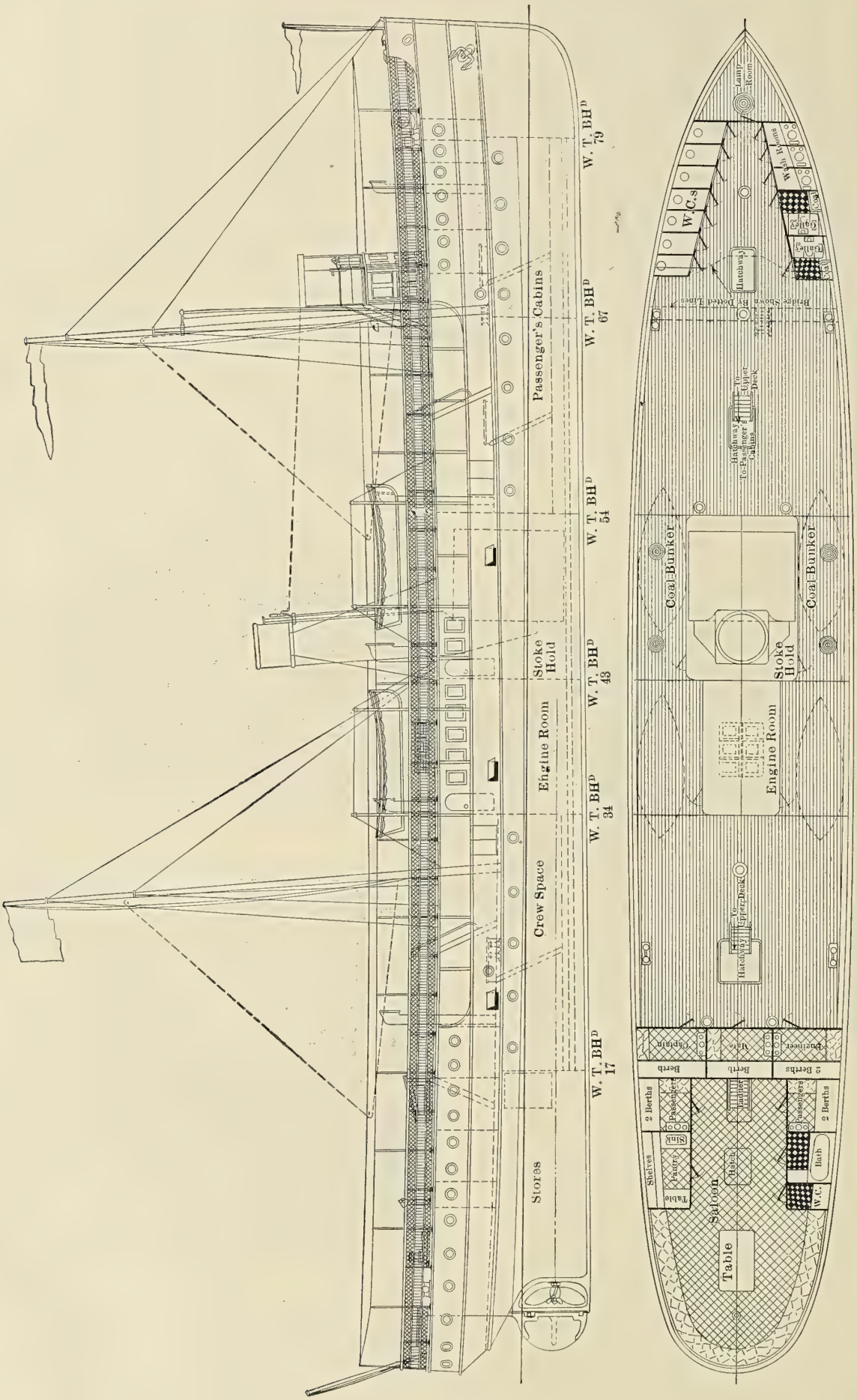
between centers, and are of angle steel 3 by 2½ inches by 6/20 inch, extending in one length, from keel to underside of main deck, except in wake of the deck erections, where they are, where practicable, carried to the under side of upper deck. Heel pieces are fitted at the center line, for 2 feet each side of keel. The floor plates generally are of 12-pound steel, 13 inches deep at center line, extending well up the bilges, and tapering to the frame depth at the heads. In the engine space, the floors are of 14-pound material, and carried up to form part of the foundation for the main engines, while in the boiler space, they are increased to 16 pounds. The reverse frames, fore and aft of the machinery space, are 2½ by 2½ inches by 5/20 inch, extending alternately to the main deck stringer plate and to the upper turn of bilge. In the machinery space, they are increased to 6/20 inch thick, and all extend on each side to the main deck stringer plate, while additional reverse frames are fitted for the length of the floors. The transom frame and the frames that carry the counter are formed of 10 and 12-pound plate, and 3 by 2½ inches by 6/20 inch angles.

The middle line keelson is formed of two bulb angles fitted back to back, each measuring 6 by 3 inches by 8/20 inch, extending on top of the floors, from the forward to the after bulkheads, at which they are well connected by deep bracket plates. Intercostal plates of 10-pound steel are fitted for three-quarters the vessel's length amidships. The bilge and side stringers are

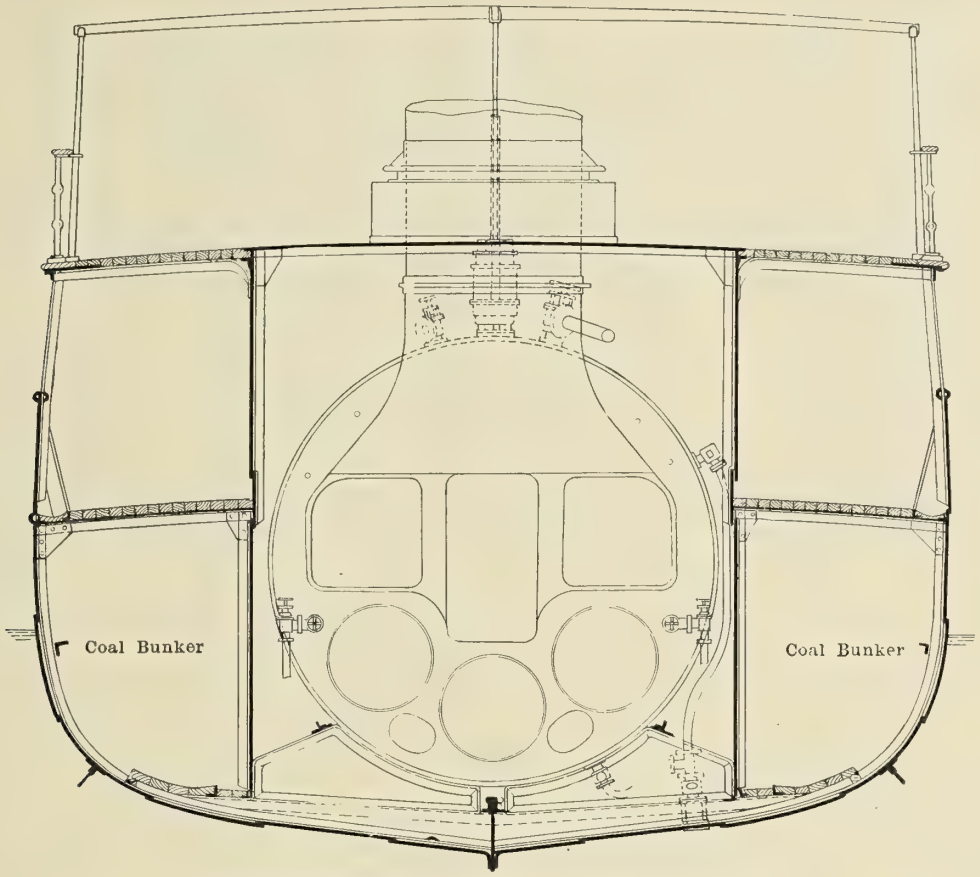


AFTER END OF MAIN SALOON ON MAIN DECK.

The skin plating includes garboard plates of 16 pounds all fore and aft; bilge plates 14 to 12 pounds; sheerstrake 16 to 14 pounds; and all the remainder 12 to 10 pounds; all the thicker plates being for about half length amidships, and gradually reduced at the ends. The bulwark and erections at each end

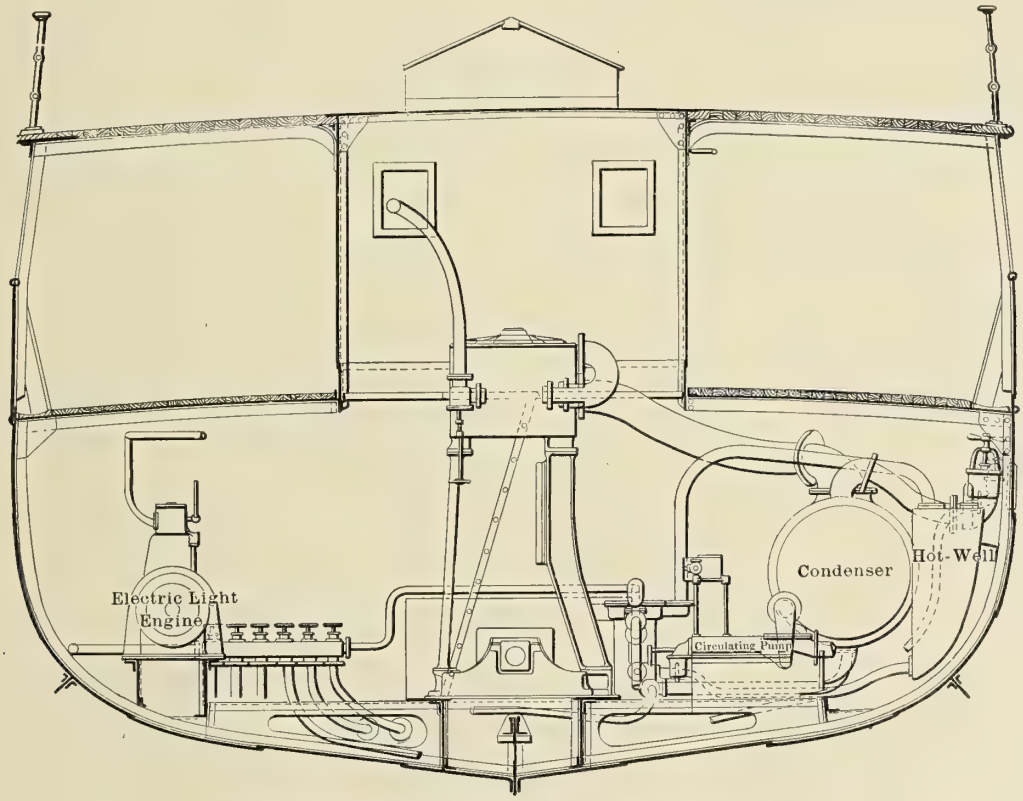


OUTBOARD PROFILE AND PLAN OF MAIN DECK OF THE STEAMER, SHOWING THE GENERAL ARRANGEMENT PLANS.



TRANSVERSE SECTION OF THE VESSEL IN WAY OF THE BOILER ROOM.

are of 10-pound plates, the plates forward in wake of hawse pipes being doubled. The bulwark stanchions are formed of bulb plates, and are connected to the stanchions which carry the promenade deck, and to the main deck, by angles. The upper edge of bulwark strake is surmounted by two hollow section convex bars 3 by 1½ inches by 10/20 inch thick. Another similar bar is worked the whole length of ship, on a line with the main deck. The fore and aft edge laps of the garboard, bilge and sheerstrakes are double riveted; the remainder are single riveted. The butts of the garboard, sheer, and bulwark

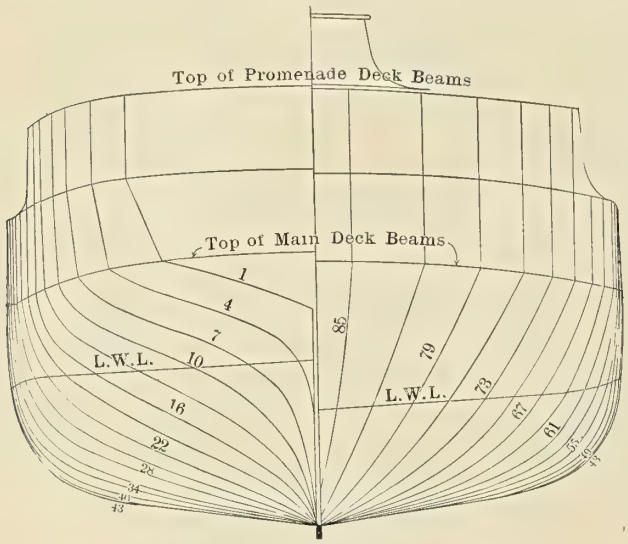


TRANSVERSE SECTION OF THE VESSEL IN WAY OF THE ENGINE ROOM.

strakes are all flush, and the butts of all the remaining are overlapped, the whole being double riveted.

There are six tranverse watertight bulkheads fitted at frames 17, 34, 43, 54, 67 and 79; all are of 10-pound plating, stiffened by angles 3 by 2½ inches by 6/20 inch thick. The vertical stiffeners are spaced 30 inches apart, and the horizontal ones 4 feet. Diamond shaped liners are fitted to all bulkheads in wake of the outside strakes of plating. Bilge keels are fitted on each side for about 80 feet. They are formed of 20-pound plates 9 inches deep, with a bulb on the outer edge, and are connected to the skin plating by double angles 3 by 3 inches by 6/20 inch thick.

The foundation for the engines is formed mainly of two longitudinal girder plates, each of 14 pounds, to which the floors are connected by double angles, and which itself extends to the skin plating and is connected thereto. The rider plates are continuous, and formed of 25-pound plates 15 inches wide, connected to the floors by angles 5 by 3 inches by 8/20 inch thick. The saddles for the boiler are three in number, each of 16-pound plates, stiffened by double angles 3 by 3 inches by 6/20 inch thick, and connected by boundary angles to the side bunkers. The bunkers are formed of steel plates, the lower part being of



BODY PLAN OF THE STEAMER KALIKA.

10-pound and the upper of 8-pound, all stiffened by angles, both vertically and horizontally, 3 by 2½ inches by 6/20 inch.

The houses on the main deck forward, consisting of toilets, stores, wash rooms and galleys, and all the casings around engine and boiler rooms, are formed of 8-pound steel, built up on coamings of 10 pounds, and are all stiffened by angles 2½ by 2½ inches by 5/20 inch thick. All the houses aft on the main deck are of teak.

The upper or promenade deck beams are of steel angles 4½ by 3 inches by 7/20 inch, and are, where practicable, in one length from side to side. They are connected at the ends, to continuous fore-and-aft stringer plates, angles, and stanchions. The stringer plates are of 10-pound material, 18 inches wide amidships, tapering to 14 inches at the ends. The continuous fore-and-aft angle is 5 by 3 inches by 8/20 inch, and the stanchions are formed of tee bars 5 by 3 inches by 7/20 inch. Twelve-pound plates are fitted on the beams, under the steam windlass, charthouse, and in wake of masts and all hatchways. The deck is formed of yellow pine, 4 inches wide by 2½ inches thick, except in wake of the engine and boiler rooms, where it is of galvanized steel checkered plates, 11 pounds thick. A margin strake 4 inches thick is fitted all around, molded on the outer edge, and hollowed on the inside, from which scupper pipes are fitted to drain water from the deck. The whole of the promenade deck is surrounded by galvanized wrought iron stanchions, with two pipe rails, and surmounted by a teak rail 5 inches wide by 2 inches thick. Galvanized iron wire work is fitted all around these stanchions and rails.

The charthouse is fitted forward on the upper deck, and is built of teak with sliding windows and hinged doors. This house contains the hand and steam steering gear, which can be worked either from in the house, or on the bridge directly over the house. Around the bridge are fitted hand rails and stanchions similar to those around the promenade deck. The rudder head is carried to above the upper deck, so that the leads from the steering gear are carried right along on top, at the sides; an arrangement whereby the leads are always open to examination, overhaul and repair.

Cabins below main deck are fitted aft, for the accommodation of the crew, and forward for second class passengers. Below the decks of these cabins are fitted the water tanks for ship's use. Aft on the main deck are staterooms for the captain, mate, engineers, and first class passengers, also the saloon, pantry, toilets, bathrooms, etc. Canvas awnings are fitted the whole length and width of the promenade and bridge decks, and carried on the usual ridge poles and stanchions.

There are four lifeboats, each 17 feet by 5 feet 6 inches, with davits for lifting same, fitted in strong iron sockets on the upper deck. In addition to the steam windlass forward for working anchors, a small steam capstan is fitted aft for warping. Two pole masts are fitted, of Oregon pine, each 12 inches diameter at the deck, to 11 inches at the hounds. The main mast is 42 feet, and the foremast 39 feet long, from hounds to main deck, each with a 15-foot pole on top.

MACHINERY.

The vessel is propelled by a triple expansion three cylinder engine, operating a single screw and designed to drive her at a speed of twelve knots under full power. The cylinders are 12, 20 and 34 inches respectively in diameter with a stroke of 20 inches. The designed indicated horsepower was 500, when running at 175 revolutions per minute. The high-pressure cylinder is forward and low-pressure aft. The slide valves are of the piston type for high-pressure and intermediate, and of the double ported D type for the low-pressure. All are worked by Stephenson link motion with double bar links.

The piston rods, connecting rods, valve spindles, eccentric rods and shafting are of forged steel. The piston valves for the high and intermediate-pressure cylinder measure respectively 5¾ inches and 10¾ inches in diameter, and each is fitted with Lockwood & Carlisle's patent spring packing rings. The liners in which they operate are ⅝ inch in thickness. The low-pressure valve measures 20¼ inches long by 33½ inches wide. The back of this valve is relieved of steam pressure by a relief ring, 13 inches in diameter. The part of this valve inside the relief ring, in addition to being relieved of steam pressure, is connected to the condenser, so as to obtain a vacuum, and thus further relieve the valve.

The steam and exhaust passages between successive cylinders are formed of solid drawn copper pipe, the diameters being as follows: main steam, 3½ inches; from high-pressure to intermediate, 4½ inches; from intermediate to low-pressure, 6¾ inches. From the port side of the low-pressure steam chest the main exhaust is led to the condenser through brazed copper pipe, 10 inches in diameter. The piston valves are arranged to take steam on the inside and exhaust on the outside, while the low-pressure valve takes steam outside and exhausts inside.

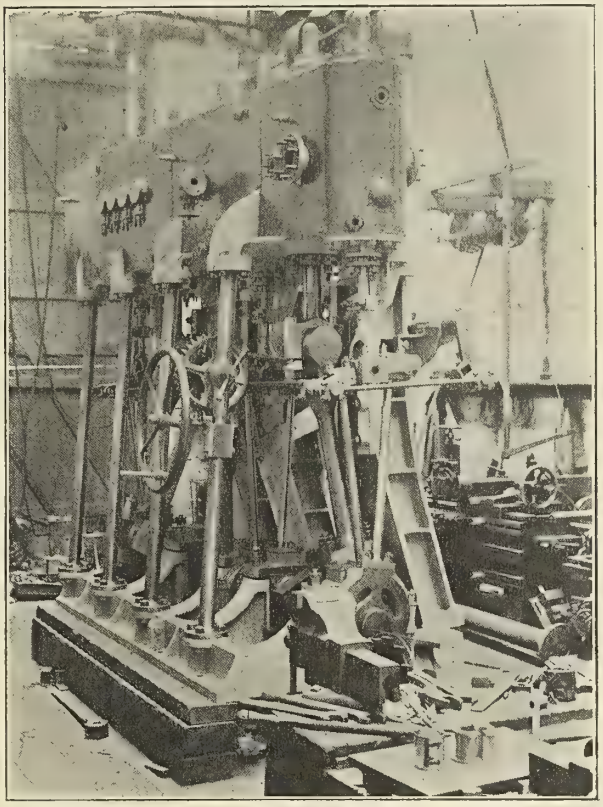
The valve spindles are 2 inches in diameter through the glands, and the eccentric rods are 1½ inches in diameter at the necks to 1⅞ inches at the feet. The eccentric sheaves and straps are of cast iron. The eccentric pins in the links are 10½ inches between centers. The engines are reversed on the "all round" principle, worm and worm wheel, hand gear. The weigh shaft is 3 inches in diameter, of forged steel, fitted in four adjustable bearings, at the back of the engines. The

high-pressure and intermediate weigh shaft levers are arranged for linking up.

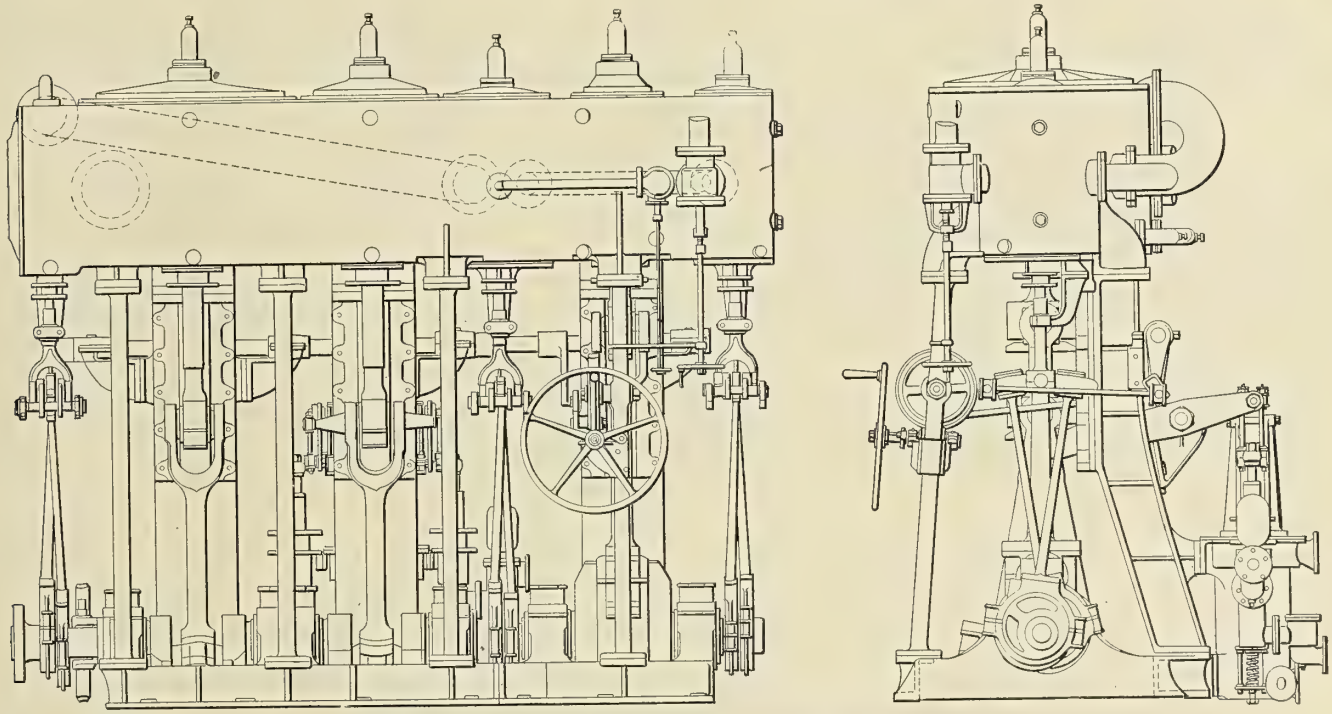
The pistons are of cast steel, cone section, the high and intermediate each having three cast iron spring rings, while the low-pressure is fitted with Lockwood & Carlisle's patent spring packing ring, each piston having a total depth of rings of 3¼ inches. The piston rods have a diameter of 3⅜ inches, and are forged solid with the crosshead. The pins of the latter are 4 inches in diameter, with a surface length of 6½ inches. The crosshead slippers are of malleable cast iron lined with white metal, and have a rubbing surface of 110 square inches on the ahead, and 84 square inches on the astern guides. The crosshead guides are of cast iron, formed in the back columns. The connecting rods are 45 inches long between centers, and have a diameter of 3¼ inches at the crosshead end and 3¾ inches at the crank end. The crosshead end is forked to span the crosshead. The bottom end is fitted with a malleable cast iron bearing, lined with white metal.

The crank shaft, with its three cranks and coupling disk, is in one solid forging, machined bright all over. The overall length is 11 feet 2 inches; the diameter of the shaft in the journals is 6¼ inches. The crank pins are 6½ inches in diameter by 9 inches long. The cranks are set at angles of 120 degrees, the high-pressure being followed by the intermediate and low-pressure, respectively. The crank arms are 7½ inches wide and 4¼ inches thick. The coupling disk has a thickness of 1⅞ inches and is 14½ inches in diameter.

The bedplate is of cast iron, flat bottom, with raised bearings for the crank shaft, five in number, having a total length of 4 feet 2 inches. They are formed of cast iron, and lined with white metal, and are held in place by cast steel caps, 1¾ inches thick, and 1½ inches diameter mild steel bolts. The front columns are four in number of forged steel, polished all over and are 3¼ inches diameter with flanges at top and bottom for connection to the cylinders and bedplate. The back columns, three in number, are of cast iron H section, and have flanges cast at each end for connections. The main air, feed and bilge pumps are grouped together, and fitted at the back of the engines, and are driven off the intermediate-pressure crosshead pin, by rocking levers and links. All the pump barrels are of cast iron lined with gunmetal in the working parts.



THE PROPELLING ENGINE, ERECTED IN SHOP.



SIDE AND END ELEVATIONS OF THE TRIPLE EXPANSION PROPELLING ENGINE.

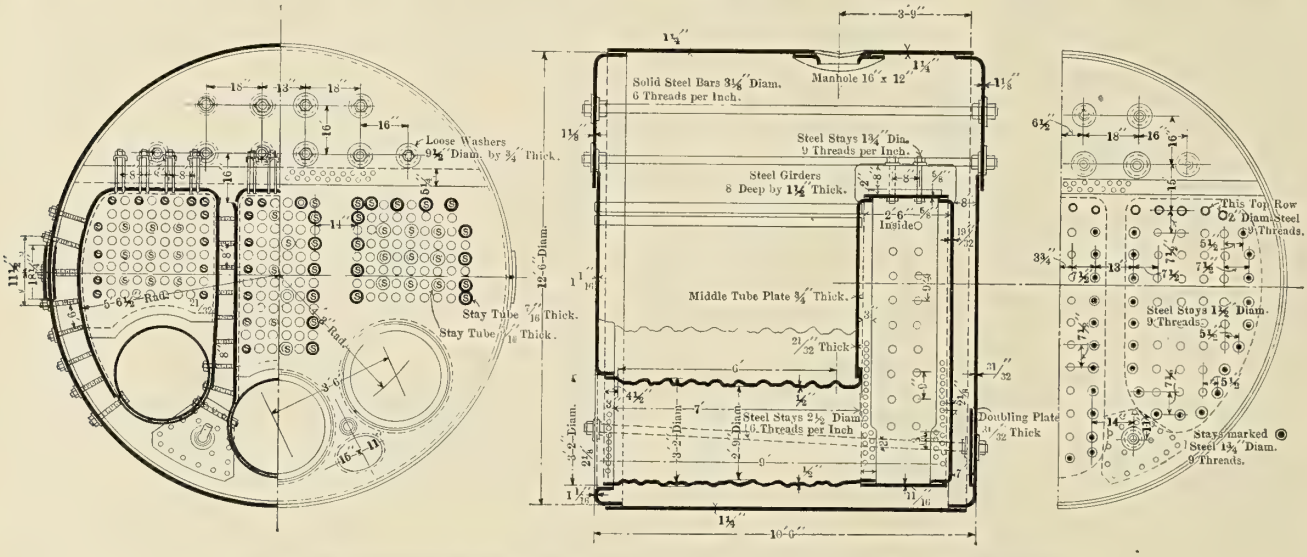
The thrust shaft is 6¼ inches diameter and 5 feet long, and has five thrust collars forged solid, 1⅛ inches thick; the space between is 2¼ inches. A coupling disk is forged at each end, having diameter and thickness the same as on crank shaft. The thrust block consists of a cast iron pedestal with five separate cast iron collars, each lined on each side with white metal, and each independently adjustable, for both ahead and astern. The thrust block is in the engine room, being fitted in the recess of the bulkhead at the after end of the engines. The intermediate shafting is 6 inches diameter and is in three lengths, each shaft being supported in cast iron plummer blocks lined with white

metal. The tail shaft is 6½ inches diameter, and is lined with gunmetal in wake of the bearings in the stern tube. All the intermediate shafts and the tail shaft have coupling disks forged on, of the same size as those on the crank shaft and thrust shaft. All the shafts are connected to each other at the couplings by six 1⅝-inch diameter bolts, fitting in reamed holes.

The stern tube is of cast iron one inch thick, with a flange cast on at the inner end for connection to the deep floor. The outer end passes through the stern post, to which it is secured by a cast iron screwed nut, so arranged that the outer bearing can be withdrawn for examination without disturbing the nut. The stern tube bearings are of lignum vitae, in strips, fitted into gunmetal sleeves, the outer bearing being 2 feet long and the inner one 7½ inches long. The propeller is of cast iron, having four blades cast solid; and is 7 feet 3 inches diameter with an increasing pitch of 9 feet at the root to 9 feet 6 inches at the tips. The mean pitch ratio is 1.276. The total developed blade area is 22 square feet. The propeller is secured to the tail shaft in the ordinary way, by fitting over a key on a taper with a screwed nut on the after end.

BOILER.

The boiler is of the ordinary marine return tube type, 12 feet 6 inches internal diameter by 10 feet 6 inches inside length. It is fitted with three Deighton corrugated furnaces, each 33 inches inside diameter, the total grate surface being 52 square feet, and the heating surface 1,570 square feet, ratio 30.2 to 1. Of this heating surface, 1,240 square feet is tube, and 330 plate. The shell is in one course, and consists of two plates 1¼ inches thick. The ends are each in two plates, the upper and lower being 1⅛ and 1 inch thick respectively. The inner tube plates are ¾ inch, and the combustion chamber plates ⅝ inch thick. The ordinary tubes are 3¼ inches external diameter in the body and No. 8 L. S. G. thick, and measure 7 feet between plates. There are 66 stay tubes, and 146 ordinary tubes, all pitched 4¼ inches apart, between centers. The efficiency of the longitudinal seam of the shell, with rivet holes 1¼ inches diameter, and 8¼ inches pitch, is 87 percent, while the efficiency of the rivet connection is 85.6 percent. The funnel is 5 feet internal diameter, and is 33 feet in height above the dead plates of furnaces. The whole of the boiler is of mild steel with the exception of the tubes, which are of iron. The boiler, together with the whole of the machinery, has been constructed under Board of Trade survey for a working pressure of 200 pounds per square inch. The weight of the boiler complete, with mountings and furnace fittings, empty, is 34½ tons, and the weight of water to working level is 163¼ tons; total, in working order, 51¼ tons, or 230 pounds per designed horsepower. The firebars are 6 feet 4 inches long, in two lengths.


Loose Washers 9½" Diam. by ¾" Thick.
Stay Tube 7/16" Thick.
Stay Tube 7/16" Thick.
Solid Steel Bars 3¼" Diam. 6 Threads per Inch.
Manhole 16" x 12"
Steel Stays 1¾" Dia. 9 Threads per Inch.
Steel Girders 8 Deep by 1¼" Thick.
Middle Tube Plate ¾" Thick.
21/32" Thick
Steel Stays 2½" Diam. 10 Threads per Inch
Doubling Plate 21/32" Thick
This Top Row 2½" Diam. Steel 9 Threads.
Steel Stays 1¾" Diam. 9 Threads.
Stays marked ◉ Steel 1¾" Diam. 9 Threads.
12'-6" Diam.
10'-0"

THE ONE SINGLE ENDED BOILER, WITH THREE FURNACES, FURNISHES STEAM FOR ALL PURPOSES.

AUXILIARY MACHINERY.

Condenser.—The condenser is circular in section, and is fitted on the port side of the ship, entirely independent of the main engines. The shell is of mild steel, ⅜ inch thick, in one plate, with the longitudinal seam lapped and double riveted. The ends are riveted to steel angle rings 3 by 3 by ⅝ inches. The length of the shell between tube plates is 5 feet 6 inches, and the diameter inside the shell is 3 feet 6 inches. The main exhaust enters the condenser at the top through a tapered cast iron branch 10 inches in diameter at the pipe end to 16 inches diameter at the condenser. Immediately beneath the exhaust branch, and over the top of the tubes, is fitted a baffle plate to prevent damage to the tubes by the sudden inrush of steam, and to assist in the distribution of the steam over the tubes. The tube plates are of naval brass, 1 inch thick, and a center diaphragm plate, ½ inch thick, is fitted in the center of length. The tubes, 786 in number, are of seamless drawn brass, untinned, and are ¾ inch external diameter by No. 18 L. S. G. thick, with an overall length of 5 feet 8½ inches. They are secured to the tube plates by brass screwed gland ferrules, and cotton cord packing. The pitch of the tubes is 1¼ inches center to center. The total cooling surface measured outside the tubes is 835 square feet. The water ends are of cast iron cemented inside, the inlet and outlet branches each being 6 inches in diameter.

Air Pump.—This is 12 inches in diameter by 10 inches stroke. All the internal fittings, such as plunger, valves, seats, guards, and gratings are entirely of gunmetal. The air pump rod is 2 inches in diameter through the gland, and 1⅝ inches diameter through the pump crosshead. The suction pipe is 4 inches and the delivery 3¾ inches diameter. The feed and bilge pump plungers are of gunmetal, 3 inches in diameter by 10 inches stroke. The suction and discharge valves are each independent cast iron boxes, all the valves and their seats being of gunmetal. All the pump rods are connected to one mild steel crosshead, which is fitted with gunmetal slippers working in cast iron guides. The suction and delivery pipes of the feed and bilge pumps are 2½ inches diameter, and the feed delivery pipe is fitted with a spring relief valve, loaded to a pressure of 260 pounds per square inch.

Circulating Pump.—The circulating pump is of the centrifugal type, driven direct by a single cylinder vertical steam engine, 4½ inches diameter, by 4½ inches stroke. The cylinder is supported on four wrought steel columns. The impeller is 17 inches diameter and well balanced, and the shaft on which it is fitted

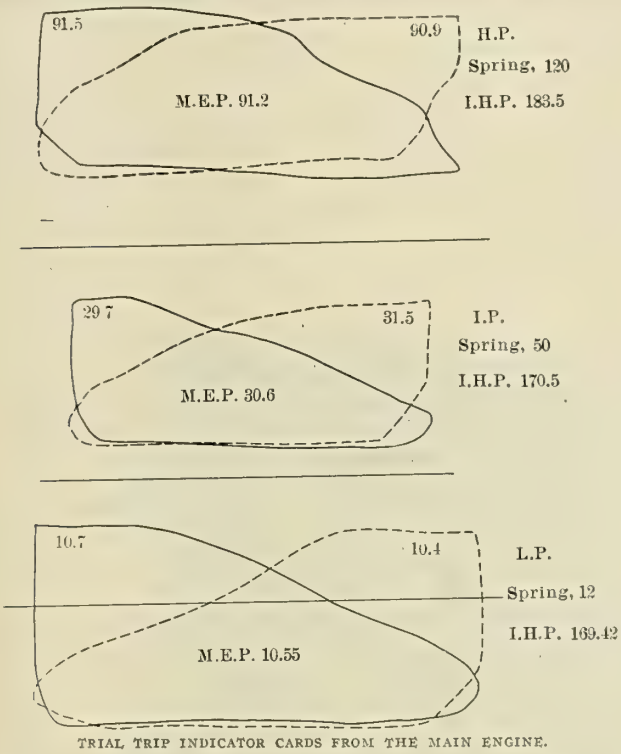
is of naval brass running in a lignum vitae bearing at the pump end, and connected to the crank shaft by coupling and bolts. The main suction and discharge branches are each 6 inches in diameter, while a bilge injection, 4 inches diameter, is also fitted. Worked off the crank shaft, and on the opposite end to that of the circulating pump, is an auxiliary air pump for use when the main engines are at rest, and the auxiliary machinery at work.

Donkey Pump.—This is of the horizontal duplex double-acting type, having two steam cylinders, 5¼ inches diameter, and two water cylinders, 3½ inches in diameter, both with a stroke of 5 inches. This pump is arranged to pump from the bilge in all the compartments of the ship, from the sea, from the hotwell, and from the bottom of condenser, and deliver to the boiler, through condenser, overboard and on deck. The diameter of the suction pipes are 2½ inches, and the delivery pipes 2 inches.

Electric Light Plant.—The electrical outfit was supplied by Messrs. Clarke, Chapman & Company, Ltd., Gateshead-on-Tyne, and consists of a single cylinder, steam driven engine, 6 inches diameter by 5 inches stroke, coupled direct to the dynamo, which operates at 100 volts at a speed of 360 revolutions per minute, the output being 70 amperes under full load. It is fitted at the after end of the engine room on the starboard side, the switchboard being attached to the bulkhead in close proximity. The total number of lights is about 120.

STEAM TRIALS.

The steam trials of this vessel were run in Start Bay, and consisted of six hours' continuous running at full speed, during



TRIAL TRIP INDICATOR CARDS FROM THE MAIN ENGINE.

which six runs were made on the measured mile, and the results obtained were highly satisfactory. The mean speed for the six hours was found to be 12.27 knots, calculated from the mean number of revolutions on the runs with those for whole time. The principal data of the trials are as follows:

Steam at boiler, average	198 lbs. per sq. in.
Steam at H. P. receiver, average	190 lbs. per sq. in.
Steam at M. P. receiver, average	64 lbs. per sq. in.
Steam at L. P. receiver, average	9 lbs. per sq. in.
Vacuum, average	26 inches
Mean revolutions, whole time	174
Mean revolutions, on runs	176
Mean pressure in H. P. cylinder	91.2 lbs. per sq. in.
Mean pressure in I. P. cylinder	30.6 lbs. per sq. in.
Mean pressure in L. P. cylinder	10.55 lbs. per sq. in.
Indicated horsepower in H. P. cylinder	183.5
Indicated horsepower in I. P. cylinder	170.5
Indicated horsepower in L. P. cylinder	169.42
Total	523.42
Mean speed on runs	12.42 knots

Why Not Do Away with Screw Propellers?

The determination of screw propeller proportions suitable for the high speed of the steam turbine is being subjected to extensive investigation, both in this country and abroad. The difficulty lies in the fact that the propeller has its highest efficiency at a relatively low speed of rotation, while the steam turbine has its best efficiency at high rotative speed; and it has been proposed to make a compromise by raising the speed of the propeller as much as possible, at the same time decreasing the speed of the turbine. A propeller, however, cannot come up to a speed that suits the turbine, and the turbine cannot be cut down in speed to suit a propeller. It would seem obvious, therefore, that no compromise is possible. But why not entirely dispense with the screw propeller in connection with steam turbines and find some other means for marine propulsion?

By increasing the revolutions per minute of a propeller, during recent experiments, it was soon found necessary to provide means to prevent the water from leaving the blades sidewise, so the propeller was put inside of a short cylindrical housing, where it was run with very small clearance. Further, it was deemed advisable to lead the water to and from the blades in the proper way, and for this reason the housing was provided with guide blades, both in front and back of the propeller. Next it has been proposed to put these parts inside of the hull in a space provided therefor, and in such case, for the sake of doing away with a long shaft, it would be just as well to place the propeller amidships near the turbine, and provide proper channels or tunnels for the inlet and outlet of the water.

We are now at the point I am driving at, for the next thing would be to substitute an *impeller* for the propeller, which would have the advantage of permitting the turbine to run at the most efficient speed. In other words, why not jet propulsion instead of screw propulsion?

There might be another way to achieve the same end without sacrificing the screw propeller, viz., to design the ship's machinery as a regular power plant, with high speed turbines direct connected to high tension alternating generators, whose current, properly transformed, could be transmitted to the slow running propeller shafts. Both turbines and propellers would in this manner work to the best advantage, and the problem of reversing would be very easily solved. Michael Nyrop, in *Power.*

Editor's Note.—Jet or hydraulic propulsion has been tried a great many times, with but indifferent success. The trouble seems to lie in the low efficiency of the pump or impeller, the combined propulsive efficiency being far below that of the screw propeller. Later experiments have shown marked improvements; but the efficiency is still too low to be commercially available.

The subject of propulsion by means of electricity generated by turbo-units has received much attention, and has strong claims to recognition. Here, again, however, efficiency fails, due to the losses in the generator and the motor, which do not exist in the direct propulsion plant. The weight is also excessive. The main advantage lies in the great flexibility of the system.

Steamship entrances into the port of Buenos Aires in 1906 included 1,936 vessels, aggregating 4,227,367 tons. Sailing vessels, 258 in number, added 262,931 tons, making a total of 2,194 vessels and 4,490,298 tons. In this total are included 2,580,592 tons (57.5 percent) under the British flag; 514,393 tons (11.5 percent) under the Italian flag; 506,358 tons (11.3 percent) of German vessels; and 309,712 tons (6.9 percent) under the French flag. The American flag is not mentioned in the returns.

GENERAL VIEW OF THE WERF GUSTO, LOOKING INTO THE FITTING OUT BASIN FROM THE OUTER BASIN.

THE WERF GUSTO OF A. F. SMULDERS IN HOLLAND.

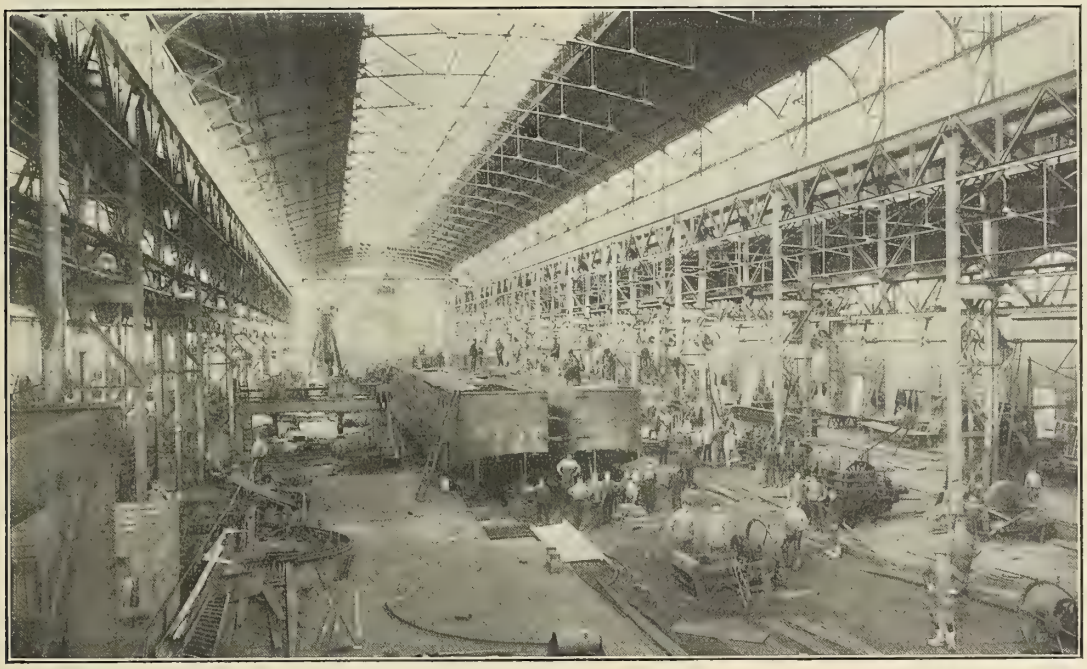
BY FRANK C. PERKINS.

The Gusto shipyards are on the Rotterdam side of the River Maas, and occupy about 15 acres at Schiedam, near Rotterdam. The great dredges constructed by this firm were utilized for reclaiming the land for this plant, which was formerly a swamp, always submerged at high tides. These Dutch engineers, in throwing the soil back and forming the solid ground on which the works was constructed, also provided a large deep water outer basin, separated from the main river by an island. There is 30 feet of water along the dock, with nearly a quarter of a mile of water front, in addition to the great erecting basin, 165 feet wide and 370 feet long. An electric traveling crane is provided on the landing stage, which has three lines of railway track for conveying the material to the various dredgers, coaling vessels, floating docks, tugs or steam hopper barges under construction.

This shipbuilding yard, which has building slips and two large engineering and construction works, is the largest and most up-to-date plant in Holland, and is equipped with the finest electrically operated machine tools constructed in Germany, France, Britain and America. The erecting shop, the foundry, the forge shops and machine shops are said to have a greater variety of electrically operated traveling cranes, machine tools, and other labor-saving devices than any other firm in Europe or America, exemplifying modern practice in the design and construction of these devices by leading firms throughout the world.

A complete electric power plant has been installed, consisting of two vertical compound steam engines of the surface condensing type, of 400 horsepower each, also a 300-horsepower engine, all of which were constructed at the plant. These engines are direct connected to continuous current dynamos of 440 volts pressure, for distributing power throughout the buildings, a motor generator being provided for supplying 220-volt current for lighting service.

ENGINEERING FINISHING SHOP, LOOKING NORTH IN EAST BAY.

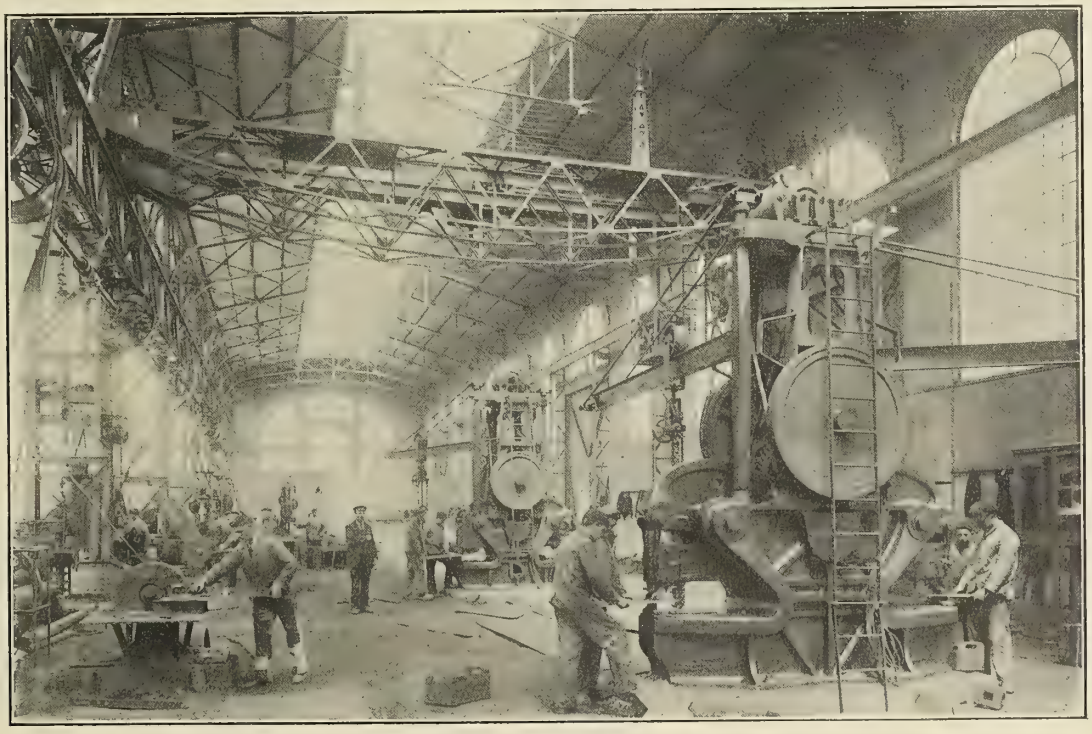


LOOKING SOUTH IN THE MAIN BAY OF THE SHIPBUILDING ERECTING SHOP.

The offices are located in the central building, together with the drawing rooms and model room. The drawing room is particularly well designed and equipped both for natural light and artificial illumination, the inverted arc being provided, with the light reflected from the ceiling.

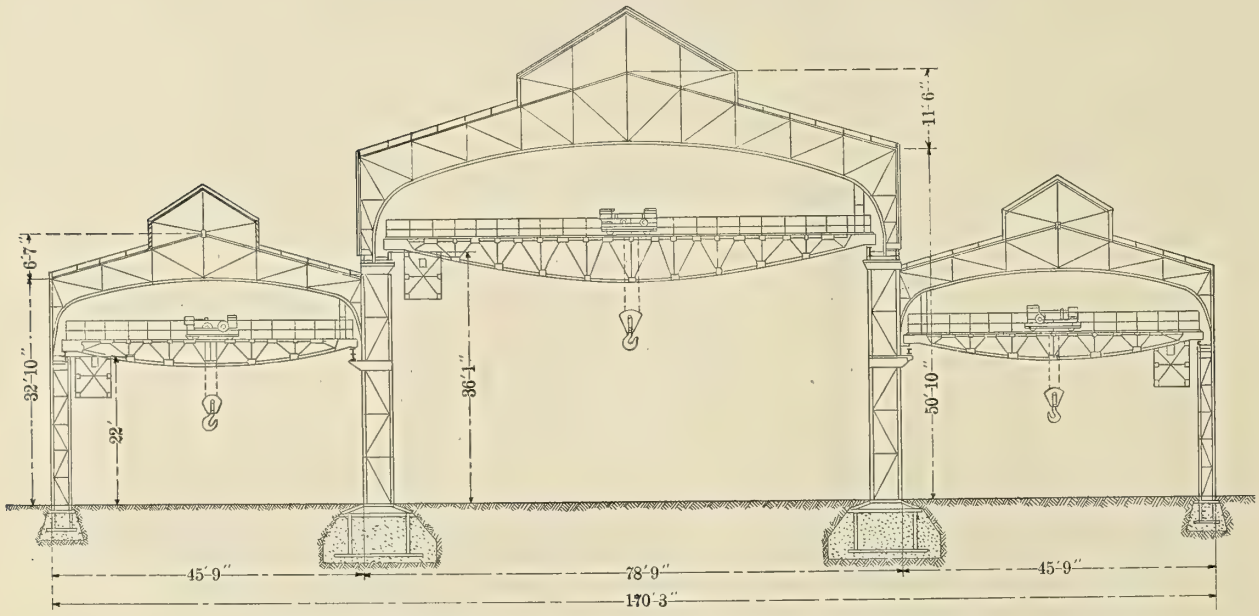
In the construction department there are many British machine tools, the engineering section having fewer English machines and more of the German, French and American type. In the eastern bay of the construction department is an electrically driven line of overhead shafting to operate the English tools not equipped with individual motors. In this bay are also a number of Dutch punching and shearing presses operated by individual motors, and a heavy punching and shearing press with an angle-iron cutter, of Craig & Donald. There are also a number of Scotch machines, including a heavy press and two punching and shearing presses built at Glasgow, the former by J. H. Riddel and the latter by J. Rennie & Son. There is also a large Smulders plate edge planer in this bay, as well as several smaller machines of Belgian and Scotch construction, and a number of angle-iron benders, automatic saws, drills, and plate bending machines. The Johns splitting-shear, built by Henry Pels & Company, New York, is a unique and interesting tool, so arranged that plates of any length and width may be sheared on any line.

There is a large German hydraulic press of 250 tons capacity, and two Massey steam hammers, in the west bay, also a plate bending press for flanging floor plates, as well as a steam



GENERAL VIEW OF THE PLATERS' SHOP, SHOWING SCOTCH PUNCHES AND SHEARS AT WORK.

THE SOUTHWEST CORNER OF THE FOUNDRY OF THE WERF GUSTO.



ELEVATION OF ONE SECTION OF THE SHOPS AT THE WERF GUSTO ESTABLISHMENT.

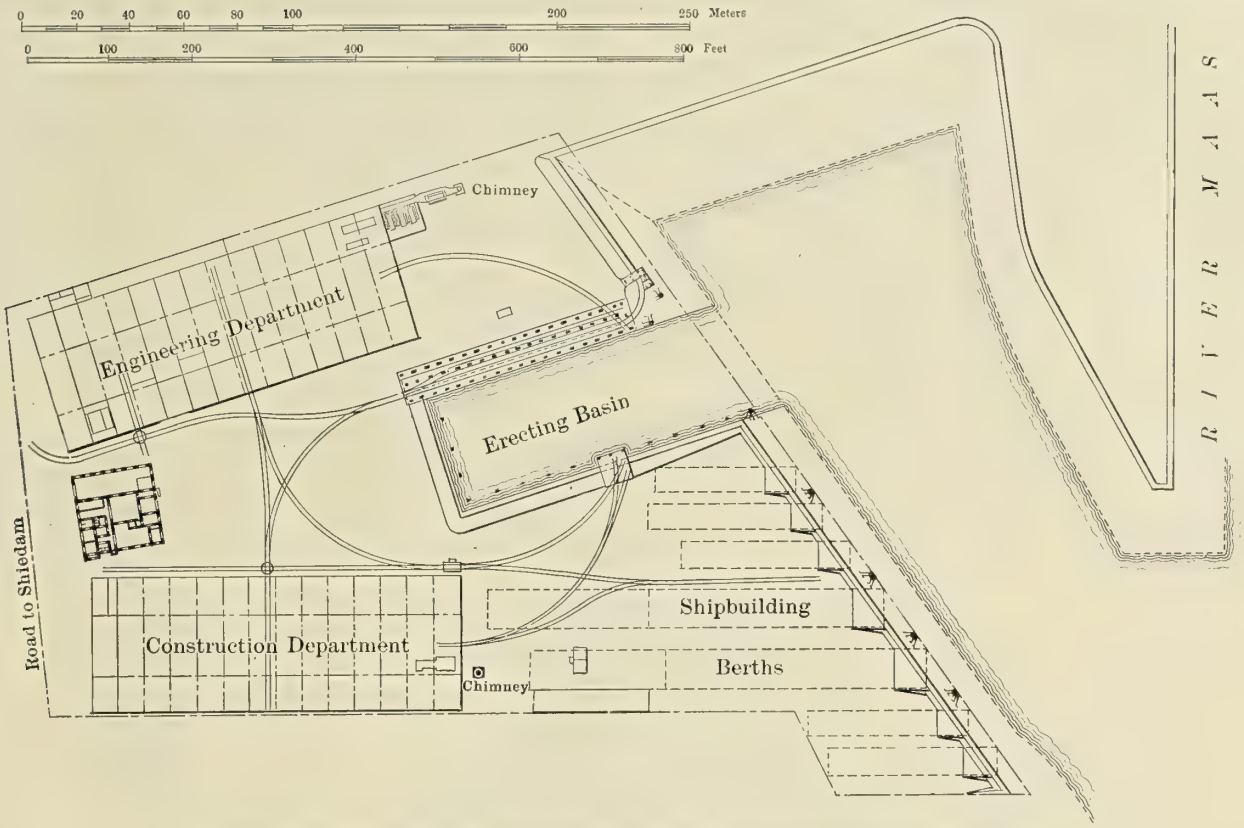
hammer of the Glenn & Ross type. The smiths' fires are located in two rows, with two furnaces for heating forgings at the end, a most complete exhaust system being provided for carrying the smoke and dirt from the hearths.

The Ingersoll-Sergeant (New York) system of air compressors is employed, a complete pneumatic plant being installed for drilling and calking, compressed air also being utilized to some extent for riveting. The air compressing plant was installed by Alfred H. Schütte, of Cologne. In the center bay of the construction building is an overhead electrically operated traveling crane of 15 tons capacity and a 5-ton electrically operated traveling crane in each of the side bays. There are rails laid throughout the shipyard, and an electric locomotive crane is provided, which takes its current from an overhead trolley system.

The heavy tools in the machine shop are located at the sides of the center bay, and include a planing machine for large castings, with a low traveling bridge working over a pit 10 feet deep. The table of this machine may be removed bodily, and the casting to the machine mounted on cross girders in the pit at any height desired. The distance between the standards is 8 feet, and the travel of the bridge 20 feet. There is a quick return, the bridge being traversed by two leading screws and the work remaining stationary.

There is also a large horizontal and vertical planing machine constructed at Johnstone, England, by T. Shanks & Company, also a German planer built by the Chemnitzer Maschinenfabrik, with two tool saddles on the bridge, and one on the standard. It is designed to take work 7½ feet wide and 7 feet high, making a cut of 21 feet. There are also a large number of smaller planing machines, and an American vertical boring mill, as well as a large English double headed lathe, both of these machines, however, being of German construction.

There are a large number of American lathes installed in the background, built by the Bullard Machine Tool Company, Bridgeport, Conn., the American Tool Works Company, Cincinnati, Ohio, and the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio. The German Niles Company and the American Niles-Bement-Pond Company, New York, have in operation in this shop a number of boring mills; while there are also several French lathes, and American grinding machines built by the Landis Tool Company, Waynesboro, Pa. A number of English, Scotch and German boring machines are also in service,



GENERAL PLAN OF THE YARD AND SHOPS OF THE WERF GUSTO, NEAR ROTTERDAM, HOLLAND.

including one constructed at Manchester by Messrs. Nasmyth, and another by G. & A. Harvey, of Glasgow. There is a large gear cutter, of German construction, built at Berlin by Reinicker, designed to cut teeth on wheels up to 5½ feet in diameter. Two Belgian vertical milling machines are in use, constructed by Messrs. Deneffe & Co., of Liege. There are a number of automatic and semi-automatic machines of American design, built by the Gisholt Machine Company, Madison, Wis., and the Jones & Lamson Machine Company, Springfield, Vt., as well as a side planer constructed at Brussels, and a number of continental shaping, milling and drilling machines.

The machine and erecting shops are 460 feet long and 170 feet wide, with three bays. The buildings are constructed of steel and glass, with electric traveling cranes operating on runways on the tops of the columns, which are 22 feet high in the side bays and 36 feet high in the center bay. The main bay is nearly 80 feet in width, while the side bays are about 46 feet wide, and run the full length of the building. There are two continuous roof skylights, in addition to the side and end windows, the summit of the main bay, not including the skylight, being 62 feet from the floor.

The foundry is about 100 feet in length, and is equipped with two cupolas and an electric elevator. There are two pits 15 feet deep and 16 feet in diameter, lined with a riveted plate structure of watertight construction, for large heavy castings. The watertight construction was required on account of the nature of the soil, and the reclaimed land on which the plant was installed. There is a portable stove for drying molds, and two core stoves 21 feet square. Castings up to 50,000 pounds in weight are made in this foundry, which is served by a long span jib crane on which a traveling pulley runs; also a 5-ton traveling crane over the side bay and a 15-ton traveling crane over the main bay.

The north end of the main bay of the shipbuilding erecting shop is shown in the accompanying illustration, with the elevator part of one of the large floating coaling machines of A. F. Smulders under construction.

New British Battleships.

Three battleships of the *Dreadnought* type have recently been laid down in England, of which the *Superb* is being constructed by Sir W. G. Armstrong, Whitworth & Company; the *Bellerophon* in the dockyard at Portsmouth, where the original *Dreadnought* was built; and the *Temeraire* in the dockyard at Devonport. The turbine machinery for these vessels is being constructed by the Wallsend Slipway & Engineering Company, the Fairfield Shipbuilding & Engineering Company and R. & W. Hawthorne, Leslie & Company, respectively.

Some improvements over the *Dreadnought* are expected, with a slight increase in displacement, from 17,900 to 18,400 tons. In order not to materially increase the draft, which will be 26 feet 8 inches in place of 26 feet 6 inches, the midship section is to be fuller, but the lines will be otherwise as fine, and the dimensions the same as in the *Dreadnought,* so that the new ships will be approximately the same in all principal particulars. One of them has already been launched.

The turbine machinery, which is designed for 23,000 horsepower and a speed of 21 knots, as in the *Dreadnought,* is to be operated by steam at a pressure of 160 pounds in place of the 240 pounds per square inch in the *Dreadnought,* while for experimental purposes superheating to the extent of about 100 degrees will probably be adopted in one of the vessels.

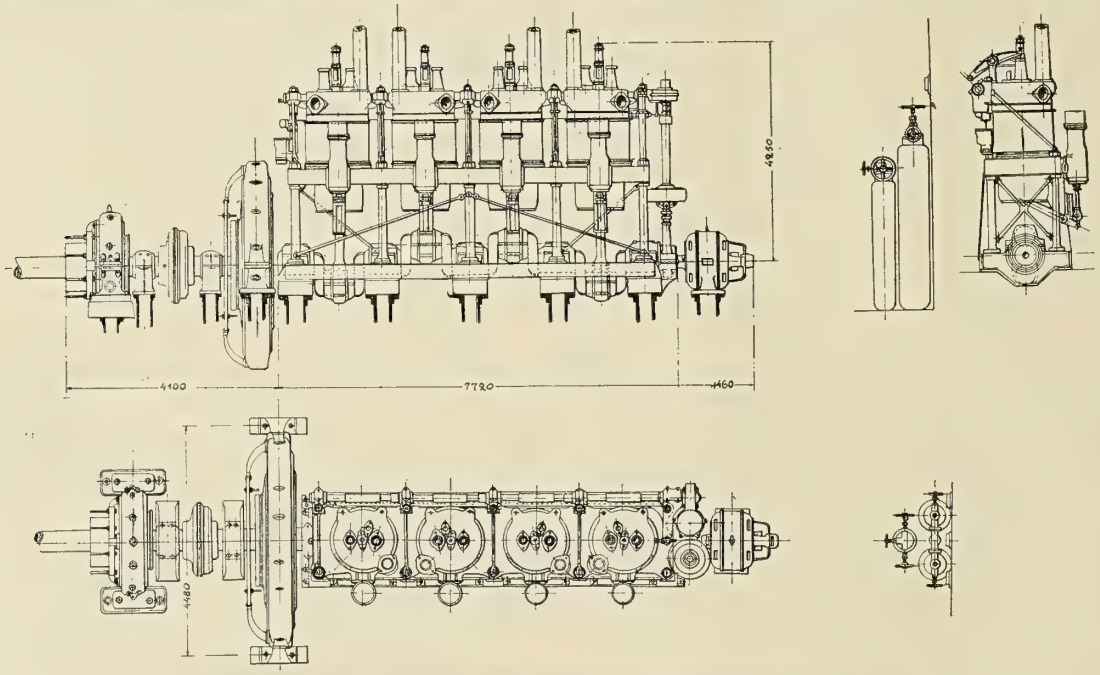
The primary battery of ten 12-inch guns will be the same as in the *Dreadnought,* except that the guns will be of a new type, and of greater individual power. The secondary battery of the *Dreadnought* consists of twenty-seven 3-inch guns, but it is reported that the new ships will have 4-inch guns, firing a 30-pound projectile in place of the 15-pounders in the prototype.

A number of rumors are afloat regarding the *Dreadnought,* one of them going so far as to state that the vessel draws 3 feet more than the designed figure. This is stated to be due to excessive weights in construction. It seems scarcely probable that errors could have been made to such an extent as to increase the displacement by more than 2,000 tons, which an increase in draft of 3 feet would represent.

THE PROPULSION OF SHIPS BY MEANS OF NON-REVERSIBLE ENGINES.

Up to the present time the machinery used in the propulsion of ships has been almost invariably of the reversing type, but for certain purposes under special conditions it has lately been found not only possible but profitable to employ for this purpose engines of a type which does not admit of reversing, and to use for the direct propulsion electric motors actuated by current from generators operated by the engines in question.

This is in general something in the nature of a complication, by virtue of requiring practically a triplication of machinery, there being the prime mover, the generator direct connected with it, and the motor. We described at page 379 of our issue for September, 1905, a construction of this character put into service on Lake Geneva, Switzerland. We now find in a supplement issued by *Rivista Marittima* in October, 1906, a very complete description of some vessels of this character, which have been put into service on the rivers of Russia, and, in addition, description of a number of projects of a like character for service as ocean passenger and cargo ships, and for military purposes. We reproduce herewith some of the drawings illustrating the general arrangement of these vessels and their machinery.



FOUR-CYLINDER DIESEL ENGINE OF 1,000 HORSEPOWER. DIMENSIONS IN MILLIMETERS.

One of the principal reasons for adopting this method of propulsion lies in the extreme economy of the Diesel motor, in consumption of fuel. The steam engine is very good which uses more than 10 or 12 percent of the energy contained in the fuel supplied to the furnaces. Diesel motors, however, have been operated at an efficiency represented by as much as 33 percent, and seem to give excellent satisfaction in spite of their limitations regarding reversibility. Another reason for adopting this scheme lies in the great flexibility which it possesses, and which is based upon the fact that the engine may be kept running at all times, while the electric motor may be operated at such times and speeds as the requirements of the service may demand. With the engine running light, that is when the electric motor is not drawing current, the fuel consumption is almost nothing, and it will readily take up any load which may be placed upon it by the starting of the motor. It may be stated in this connection that the Diesel engine operates at practically a single speed, and hence would not be available directly for propulsive purposes. It is estimated that the ratio in consumption of fuel between the ordinary steam engine and the Diesel engine is about 5 to 2, which means that with equal quantities of fuel on board the radius of action of the ship would be increased about 150 percent by the use of the Diesel engine. Another point of superiority, which, however, applies equally to all forms of liquid fuel, is that the fuel may be carried in compartments of the vessel which would otherwise be unoccupied, and would, therefore, be waste space. The double bottom is an instance of this.

The Diesel engine operates on an approximation of the Otto, or common gas engine cycle, having one working stroke in every four. Its cycle differs from the Otto, however, in that on the first stroke it draws in a full cylinder of air only, which is compressed on the next stroke to a pressure of about 35 atmospheres, with a consequent temperature sufficient to ignite any liquid fuel which may be injected into it.

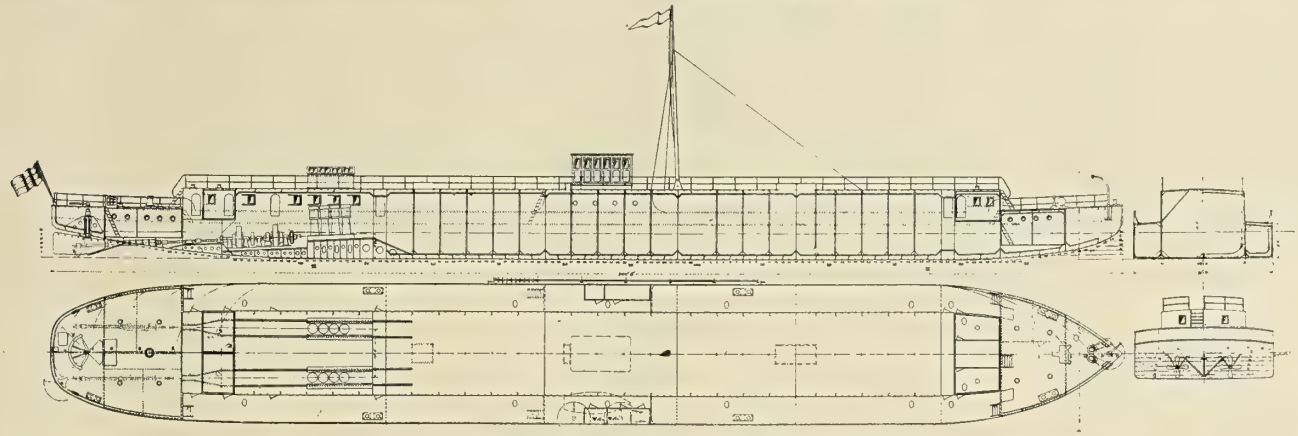
At the top of the second stroke the fuel valve is opened, and a certain quantity of oil in a highly atomized state is injected into the cylinder, by means of a jet of highly compressed air from an auxiliary reservoir, and burned as it enters, the remainder of the third or working stroke being taken up with the expansion of the burned gases. The fourth stroke scavenges the cylinder of the products of combustion, and prepares it for another charge.

In the Diesel engine the governor operates a valve in a by-pass tube connected to the fuel pump. The pump raises a maximum quantity of the fuel at each stroke, the quantity injected into the cylinder depending on whether the governor permits the oil to flow to the admission valve by closing the by-pass valve, or returns it to the supply tank. There is a surplus of air left in the cylinder after ignition, even with a maximum injection of oil into the cylinder, so complete combustion attends each stroke, no carbon being deposited or unburned gases exhausted.

On being pumped to the fuel valve, the oil is injected in a fine spray by a jet of highly compressed air stored in an auxiliary tank. This reservoir is maintained at a pressure of some 5 atmospheres above the highest point of compression in the cylinder, by a two-stage compressor system. This air is also used for starting the engine. The oil burns gradually as it is injected through about one-tenth or one-twelfth of the motor stroke, so that a sudden impulse or hammer blow is not given to the piston, as is the case with an engine of the ordinary explosion type.

The Diesel engine burns crude or fuel oil, petroleum distillates and some engines are now operating successfully on water-gas tar to advantage. The cheaper grades of oil fuels have practically the same calorific value as the lighter and more expensive kerosene, gasoline, etc., hence the marked economy.

Full load may be applied in less than 2 minutes and it is not necessary to warm a hot chamber, depend upon an electric igniter, or to wait until the engine becomes heated before throwing on the load.



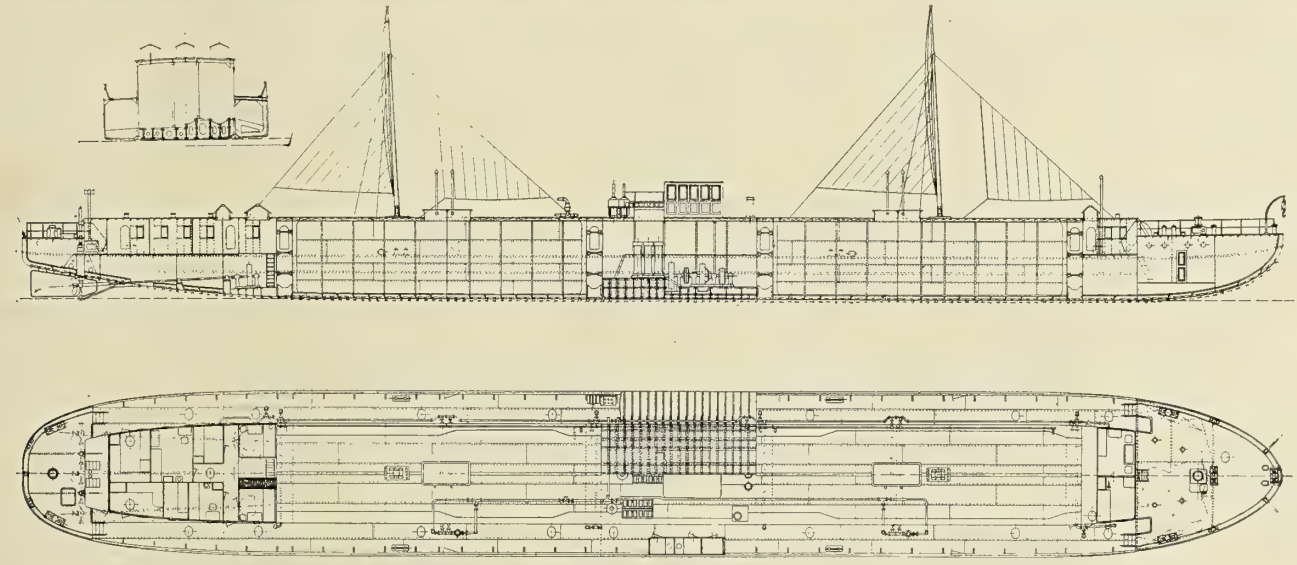
RUSSIAN RIVER BOAT SARMAT, PROPELLED BY TWO FOUR-CYLINDER DIESEL ENGINES WITH GENERATORS.

The general method of construction by which this apparatus is operated varies according to the case in hand. In the barge on Lake Geneva, which we described some months ago, the engine, generator, exciter, motor and propeller were all on one shaft, which was broken between the exciter and the motor for the introduction of a clutch. When the propeller was not operated at the full speed of the engine, this clutch was not in use, and the two portions of the shaft ran at different speeds, the after portion being actuated by the electric motor alone. When, however, synchronism in revolutions was attained, the clutch was thrown into action, and the propeller was actuated directly by the engine. In the case of the *Vandale,* illustrated herewith, a different method is adopted. The vessel is propelled by three screws each actuated by an electric motor, the latter being situated as shown near the stern, and requiring, therefore, only a short length of shafting. Three Diesel motors, located amidships, operate as many generators with exciters on the same shaft. This method, of course, does not admit of the direct driving of the propellers by the engine, but possesses all the other features of flexibility as above mentioned.

The *Vandale* is a cargo barge having a large hold forward of the machinery and another aft. The living quarters are partly aft of the after hold, and immediately above the electric motors and shafts. Two staterooms are located forward of the forward hold, with crew space in the forecastle. The vessel has a length between perpendiculars of 244 feet 6 inches; a beam of 31 feet 9 inches; a depth of 10 feet 11 inches and a draft of 6 feet. The displacement amounts to 1,150 tons, of which 750 is available for cargo, the total weight of hull, machinery and equipment being 400 tons.

The three Diesel motors have a total of 360 horsepower, which is sufficient for a speed of 7.4 knots with cargo, or 8 knots when the vessel is light. The total weight of machinery is 81 tons, which corresponds with 585 pounds for each horsepower transmitted to the propeller shaft, or 529 pounds per indicated horsepower.

The *Sarmat,* which we also illustrate, has the same dimensions as the *Vandale,* but the method of propulsion is that adopted in the Swiss barge previously mentioned. There are two four-cylinder Diesel motors located aft and connected with the generators, exciters, clutches and electric motors, as in the case of the Swiss vessel. The total weight of machinery on the *Sarmat* is 65 tons, although the total power is the same. This represents a weight of 397 pounds for each horsepower delivered to the propeller shaft, or 353 pounds per indicated horsepower. The speed is 8.6 knots light, and 8.1 knots loaded.



RUSSIAN BOAT VANDALE, PROPELLED BY THREE THREE-CYLINDER DIESEL ENGINES AMIDSHIPS, WITH GENERATORS.

The general arrangement shows four holds separated by watertight bulkheads and covering the greater part of the length of the vessel amidships. The officers are quartered aft and the crew forward. The *Vandale* has been in service since 1903. Her engines operate at 240 revolutions per minute, while each

generator supplies direct current at 500 volts pressure to the extent of 87 kilowatts maximum. The electric motors have each a capacity for 75 kilowatts. The system of regulation is so splendidly provided for that it is possible to change the direction of operation of the propellers, when running full speed ahead, to full speed astern in ten seconds.

The superior speed of the *Sarmat,* as compared with the *Vandale,* is due to the more intimate relations existing between the prime mover and the propeller. There is less loss of power through the transmission through a plurality of devices, there being in fact no such loss as is necessarily a feature of the operation of both generators and motors. The result is that a larger proportion of the 360 horsepower delivered by the engine is transmitted to the propulsive agency in the water, and a considerably greater thrust horsepower is developed.

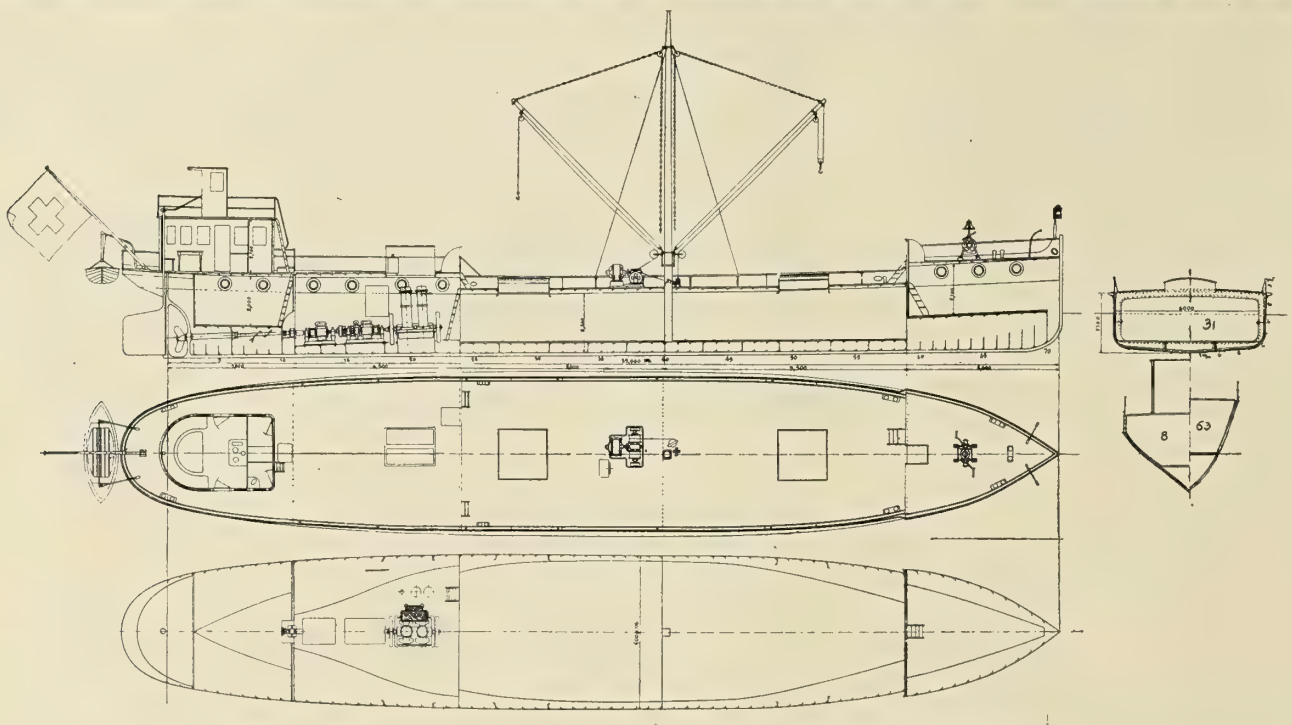
A larger engine, designed on this same system, is also illustrated, and it will be seen that the exciter is placed just forward of the engine, instead of between the generator and the clutch. The cylinders have each a diameter of 27½ inches, a stroke of 30.3 inches and operate at 150 revolutions per minute. The effective power of the engine is 1,000 horsepower; the weight of the engine with accessories being 100 tons; that of the dynamo, 24.3 tons; of the electric motors, 13 tons; of the exciter, 3.5 tons; and of the magnetic clutch 1.8 tons. This make a total of 142.6 tons for one engine, which represents 315 pounds per effective horsepower, or 287 pounds for each indicated horsepower. The consumption of petroleum per effective horsepower per hour is estimated to be not more than 0.41 pound. The total height of the engine above the center of the shaft is 13 feet 11 inches. The length of the engine proper is 25 feet 3 inches, to which must be added the exciter, 4 feet 10 inches, at one end, and the motor, clutch and generator, at the other end, 13 feet 6 inches. This makes a total length of 43 feet 7 inches. The maximum width is determined by the generator, the distance between holding down bolts at the outside of its frame being 14 feet 9 inches.

The Swiss vessel, above mentioned and previously described, is the *Venoge,* which we illustrate. The boat is used for cargo and measures 115 feet molded length, with a beam of 19 feet 8 inches, a depth of 8 feet 2 inches amidships at the center line, and a draft of 6 feet 3 inches. The displacement is 125 tons and the speed, with about 45 horsepower, is 6½ knots. The general layout, with cargo handling gear operated by electric motor, is shown in the illustration. This motor is actuated by current taken from the main generator on the propelling shaft, the clutch between this generator and the propeller being disconnected. It will be noted that propulsion is by means of a two-cylinder engine, with flywheel at either end.

The Diesel motor gives from 40 to 45 effective horsepower at 260 revolutions per minute. The generator, which is of the direct-current type, has been designed to give voltages varying from zero to 110 volts, and furnish a normal of 20 horsepower, being able, however, to accept a momentary load of 40 horsepower. The motor may be operated from a zero speed to a maximum in either direction. It is, therefore, possible to obtain in making landings a satisfactory speed without jar or shock, while the starting device acts not only upon the main circuit, but also upon the excitation of the generator.

A special electric motor has been designed to operate the capstan placed upon the boat, and a switch placed upon the switchboard near the machine permits the sending of the current from the generator into either the motor operating the screw or that for the capstan. The latter is composed of a roller, with two drums operated by means of an endless chain, the drums being able to operate separately or together, according to the weight of the load which is to be raised. The motor operating the capstan is capable of furnishing a normal of 8.8 horsepower. The speed of the motor is 1,250 revolutions per minute, corresponding with a hoisting speed of 32 meters (105 feet) per minute, with a load of 500 kilograms (1,102 pounds). When necessary, the speed may be increased to 2,500 revolutions per minute, corresponding with a hoisting speed of 64 meters (210 feet), with a load of 250 kilograms (551 pounds). The starting device is placed beside the capstan, and carries a brake acting upon the shaft of the motor, permitting the descent of the load to be carefully regulated. This starting device is similar to that of the motor operating the screw propeller; that is to say, it acts by means of a current from the generator, and permits a variation of speed from zero to a maximum in either direction.

All the electric connections between the separate pieces of apparatus and machines are carried in cables of lead, which are proof against moisture. The complete electric equipment has been installed by the Company of Electric and Mechanical Industry, of Geneva.



SWISS LAKE VESSEL VENOGE, PROPELLED BY A TWO-CYLINDER DIESEL MOTOR WITH GENERATOR.

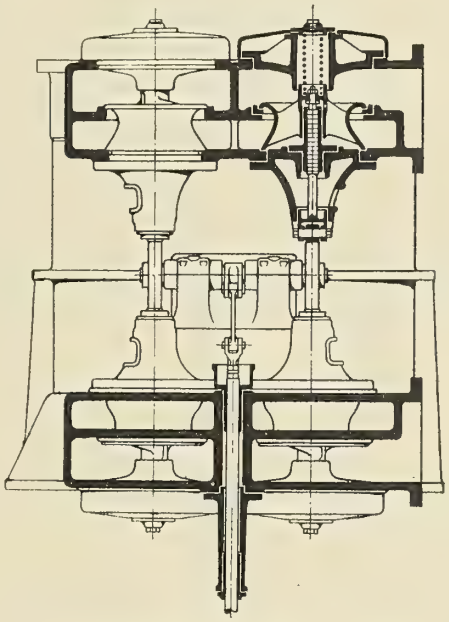
THE NEW FREIGHT STEAMER LA RANCE, FITTED WITH PIELOCK SUPERHEATING BOXES.

The French Cargo Steamer La Rance.

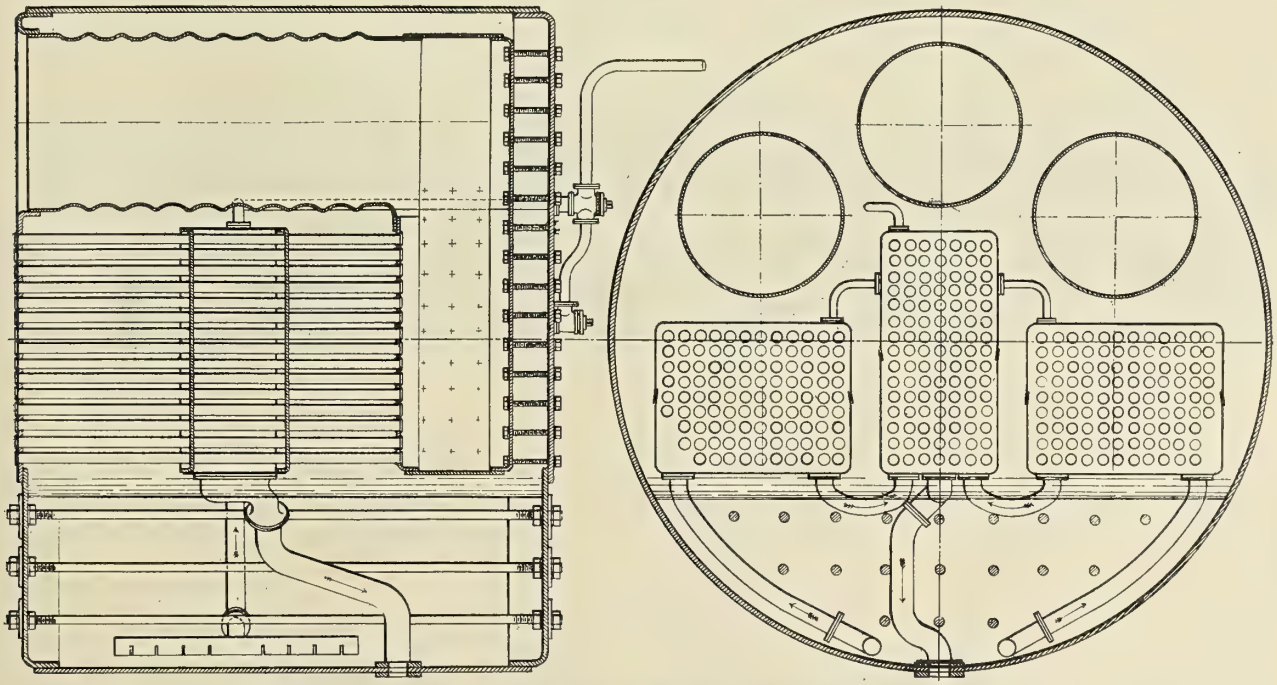
The recently constructed freighter *La Rance* has a three-cylinder vertical triple-expansion engine, with valve gear of the Lentz type, supplied with steam by two Scotch boilers with Howden's system of forced draft, and provided with Pielock superheaters. The ship is 91 meters (299 feet) long, with a draft of 6.4 meters (21 feet) loaded, the breadth being 12.2 meters (40 feet) and the depth of hold 7.75 meters (25½ feet), while the dead weight capacity is 3,650 tons. The *Garonne,* a sister ship, was built at the same shipyard, that of the Société Anonyme des Chantiers de St. Nazaire, for the Compagnie Générale Transatlantique.

The engines developed on the trial trip 1,290 horsepower, with a coal consumption of 0.408 kilogram (0.9 pound) per horsepower hour, the steam pressure being 13.453 kilograms per square centimeter (191 pounds per square inch. The engines of each ship have a stroke of 1,066 cm. (42 inches) while the high, intermediate and low-pressure cylinders measure respectively 584 cm. (23 inches), 914 cm. (36 inches), and 1,498 cm. (59 inches) in diameter. These engines operate at a speed of 75 revolutions per minute, the piston speed being 160 meters (525 feet) per minute.

During the test it was shown that there was an increase of

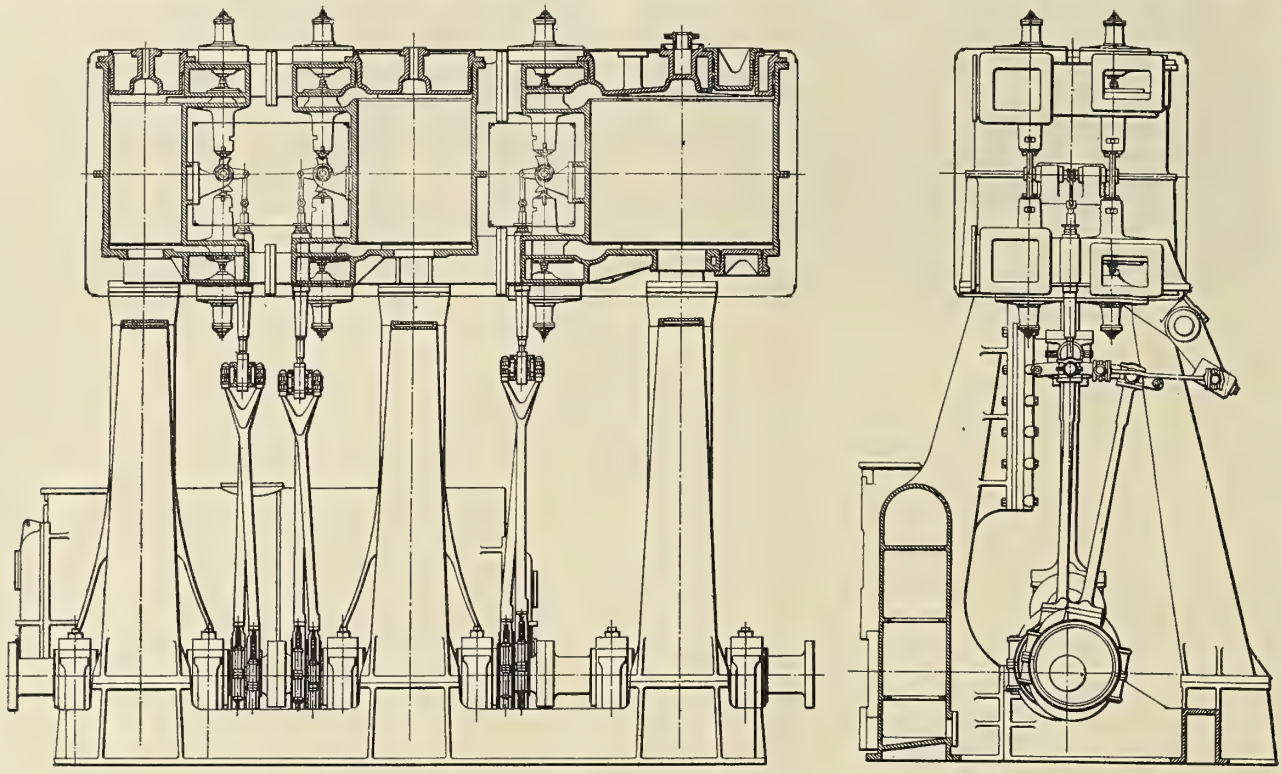


STEAM-DISTRIBUTING VALVES OF LA RANCE.



LONGITUDINAL AND TRANSVERSE SECTIONS OF BOILER, SHOWING SUPERHEATER BOXES.

power of 18 percent due to the use of superheated steam, and a decrease in steam consumption of 20 percent in favor of the *Rance* engine over that of the *Garonne,* the latter not being provided with superheated steam. The coal consumption of the *Garonne* engine was found to average for the trial 0.511 kilogram (1.126 pounds) per horsepower hour, with a horsepower of 1,101, a steam pressure of 196.6 pounds per square inch and a speed of 73 revolutions per minute.



LONGITUDINAL SECTION AND END ELEVATION OF THE TRIPLE EXPANSION ENGINE.

The boilers on the *Rance* have a heating surface of 350 square meters (3,767 square feet), and a total grate area of 8.4 square meters (90.4 square feet); the superheating surface being 73 square meters (786 square feet). The ratio of net heating surface to grate surface is 41.6 to 1; of gross heating surface, 50.3 to 1. Lap-welded tubes of mild Siemens-Martin steel are used, and boiler plates of the same material, with 23 percent elongation and a breaking strain of 28 to 32 tons per square inch.

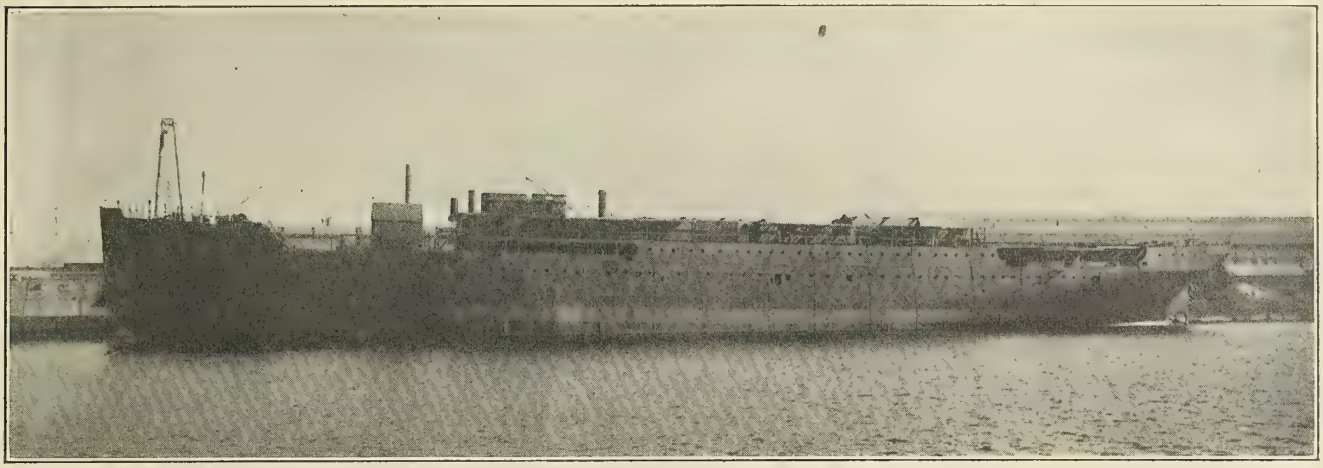
The Pielock superheater used raises the temperature from 393 to 752 degrees Fahrenheit (200 to 400 degrees C.), and is automatic in action, requiring, it is claimed, no attention and no maintenance, and working with absolute safety. Dished plates are used in the construction, these being surrounded by two bent plates forming the casing, which is 0.78 inch in thickness, while the dished plates are 0.39 inch thick.

The *Rance* engine has a much less fall of pressure on the admission than the *Garonne* engine, even though the cutoff is earlier on the high-pressure cylinder. It is also stated that in the *Rance* engine the vacuum is higher in the low-pressure cylinder than in the *Garonne,* indicating the influence which the quick opening and closing of the valves has upon the operation of the engine, as compared with the action of the slide valves on the *Garonne,* where there is more or less wire drawing of the steam.

GENERAL VIEW OF THE CHANTIERS DE L'ATLANTIQUE. ERNEST RENAN BETWEEN GUADELOUPE (LEFT) AND PEROU (RIGHT).

The French Liners Guadeloupe and Perou.

During the winter of 1906-7 there were launched from the yards of the Chantiers de l'Atlantique at St. Nazaire, France, for the West Indies service of the French Transatlantic Company, two new steamers having a length over all of 447 feet 10 inches, an extreme beam of 51 feet 10 inches, a depth of 34 feet 6 inches and a draft astern when fully loaded of 23 feet. The gross tonnage is 6,800; the horsepower 6,500 in two



THE FRENCH LINER PEROU LYING AT THE PENHOUET PIER OF THE CHANTIERS DE L'ATLANTIQUE.

engines operating twin screws; and the designed speed is 18 knots.

The hull is of Siemens-Martin steel throughout, fitted with a cellular double bottom having a total capacity of 27,200 cubic feet. The hull is divided into twelve watertight compartments, the intervening bulkheads being pierced by the necessary watertight doors.

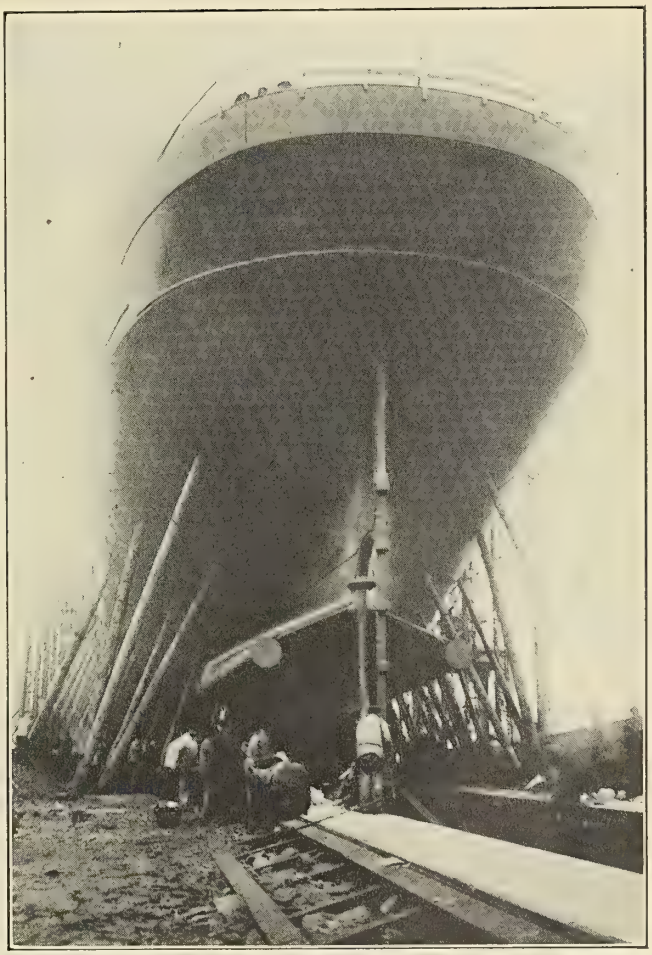
The steamer has five decks, including, above the main deck, promenade and awning decks. On the first 'tween deck are the crew's quarters, hospital and dispensary, with steerage and third class passenger accommodations forward and aft, and first and second class rooms amidships. On the main deck are the petty officers and stewards, the first class smoke room and dining saloon, and the galleys in way of funnels. Aft of this is the second class social hall, with the steering gear at the stern. On the promenade deck are the first class social hall, music room and apartments de luxe. The only accommodation on the awning deck takes care of the captain and officers, the navigating bridge and chart room being above. All apartments are heated by steam, while the first class social hall, dining saloon and apartments de luxe have also electric radiators. As the ships are to be employed in hot climates, special attention has been paid to ventilation, which is accomplished by means of electric fans, small fans being located in each apartment.

The twin screw engines are of the triple expansion type, located in separate watertight compartments. The cylinders have diameters of respectively 27, 43 and 72 inches, with a common stroke of 48 inches. They will be operated at 90 revolutions per minute. Steam is supplied by six Scotch boilers working at a pressure of 185 pounds per square inch, and fitted with the Howden system of forced draft. The grate area is 350 square feet and heating surface 13,500, giving a ratio between the two of 38.6 to 1. The boilers of the *Perou* are fitted with superheaters of the Pielock type, while the engines have Lentz slide valves. Both ships have a complete electric lighting outfit, the dynamos having sufficient capacity to supply power also for ventilation, capstans and boats' winches.

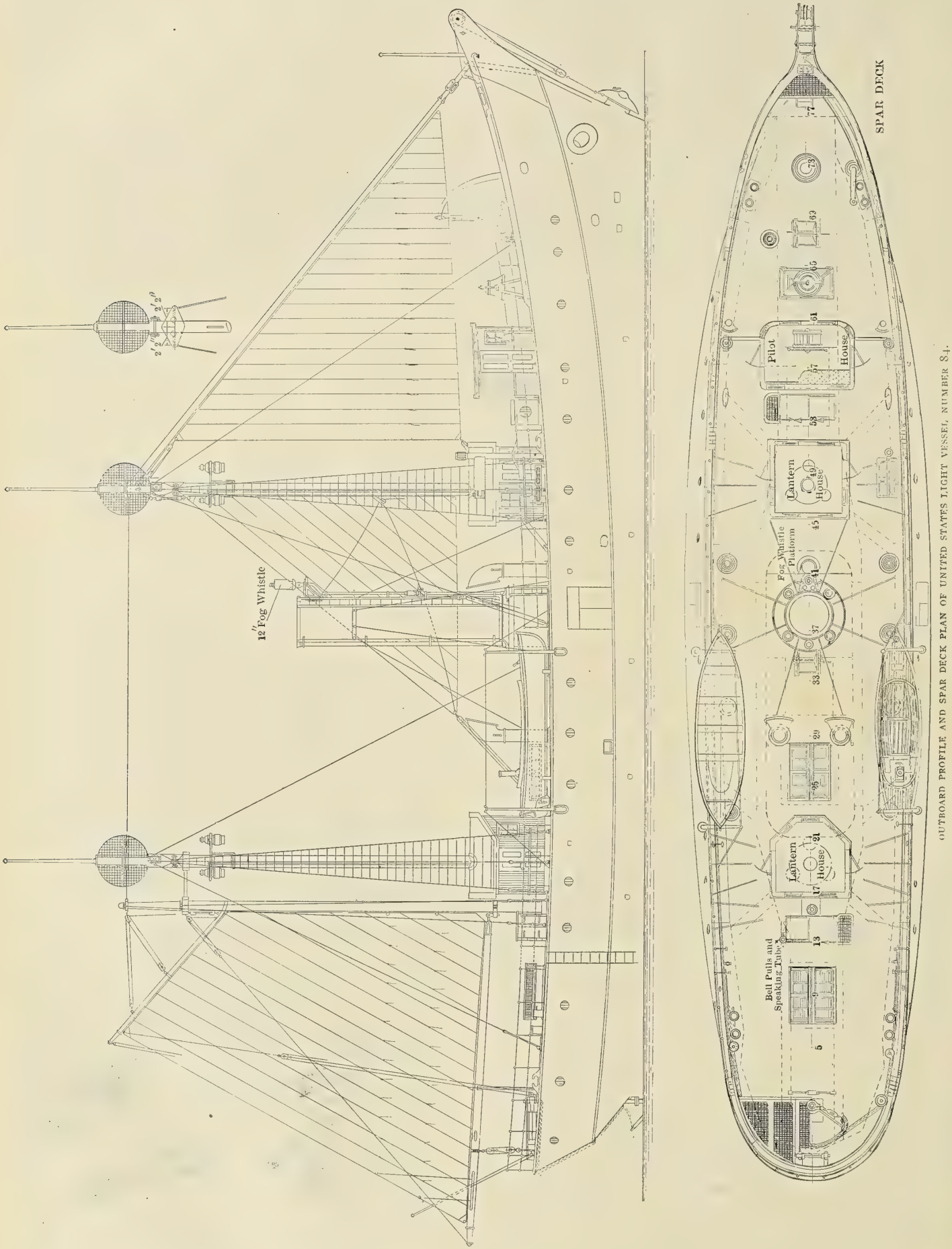
Accommodations are provided for 118 first class passengers in forty state rooms and two suites de luxe; 72 second class in twenty-four state rooms; 42 third class in nine state rooms; besides 78 in the steerage; a total of 310 passengers. The crew comprises 5 officers, 30 seamen, 56 in the engine room staff and 43 in the steward's department, making a total of 134. The life boats are of steel, and are fitted on quadrant davits of the Welin type. The steerage apparatus includes electric control and annunciators.

J. Peltier.

Austrian Subsidies.—The government of Austria-Hungary has just increased, for a period of fifteen years, its annual subsidy to the Austrian Lloyd Steam Navigation Company, from the present $1,181,460 (£242,774) to a total of $1,486,586 (£305,473). The new contract calls for ships of increased speed to the Levant and the Orient, and the government refunds the toll fees paid by the company for the passage of its ships through the Suez canal. The company is to pay into a pension fund for its employees an annual minimum of $50,750 (£10,428), and to institute an insurance fund for the crews of its ships.



PREPARING TO LAUNCH THE GUADELOUPE.



OUTBOARD PROFILE AND SPAR DECK PLAN OF UNITED STATES LIGHT VESSEL, NUMBER 84.

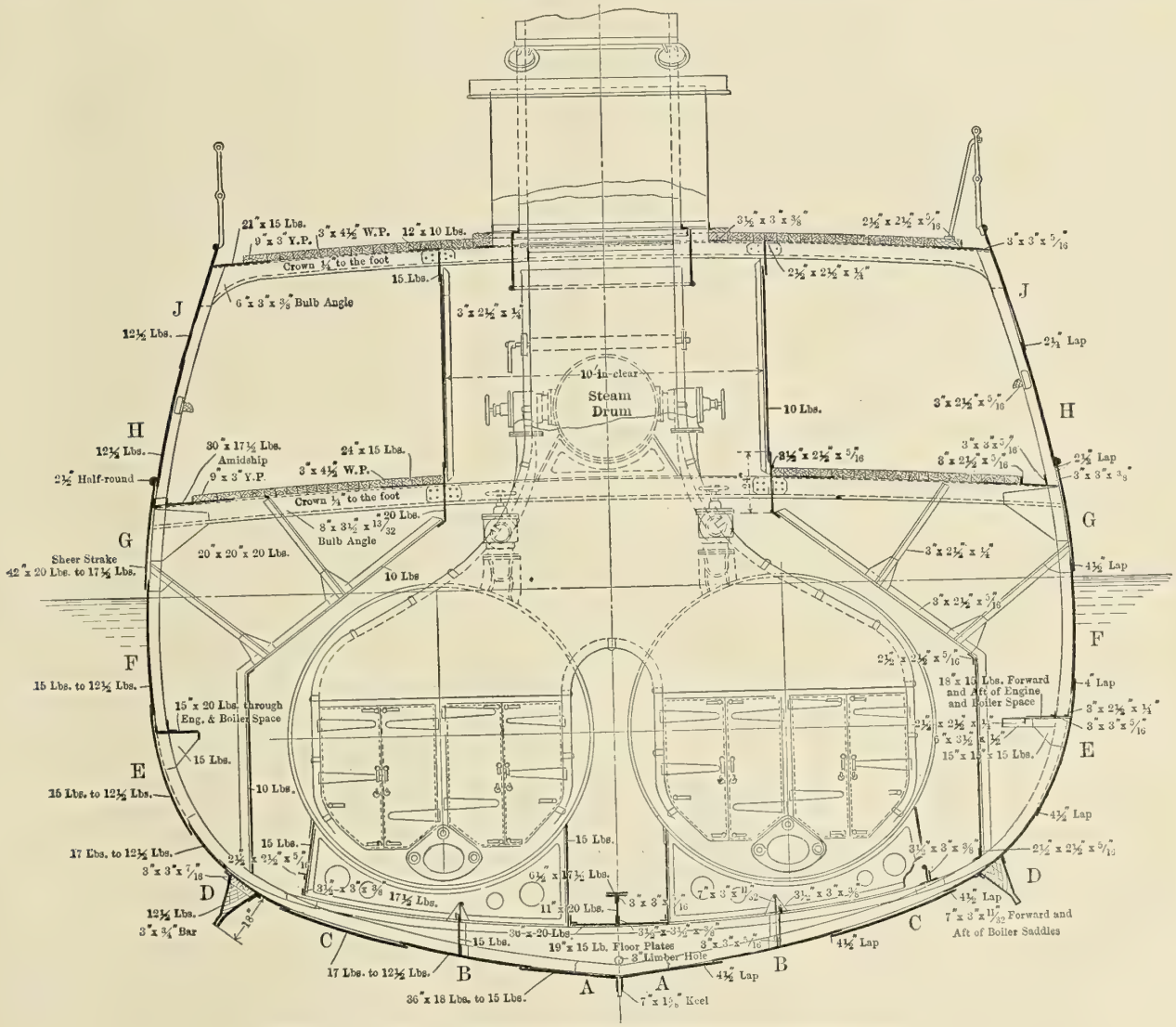
SINGLE SCREW STEAM LIGHT VESSELS.

The United States Government has adopted a standard specification for steel light vessels, propelled by a single screw actuated by a compound steam engine, and five of these vessels have been placed under construction, one of them at the works of Harlan & Hollingsworth, Wilmington, Del., and the other four in the yard of the New York Shipbuilding Company, Camden, N. J.

The illustrations give a good general idea as to the appearance, form and construction of these vessels and their machinery, and show how thoroughly well adapted they are to the use to which they are put.

The principal dimensions are:

Length over all	135 feet 9 ins.
Length on waterline	112 feet 11 ins.
Beam, molded	29 feet 0 ins.
Depth to top of keel	15 feet 4 ins.
Mean draft	12 feet 9 ins.
Displacement	660 tons



SECTION AT FRAME 41, LOOKING AFT, SHOWING SCANTLINGS AND PLATING LAYOUT.

Each vessel is built of mild steel, and has four transverse watertight bulkheads, while a watertight flat at the bow and one at the stern, uniting with bulkheads, form trimming tanks. The vessel has three decks, the main and spar decks being continuous, while the lower deck extends from the stem to the coal bunker bulkhead and from the stern post to the after engine bulkhead. Bilge keels are fitted, as shown in the drawings.

THE HULL.

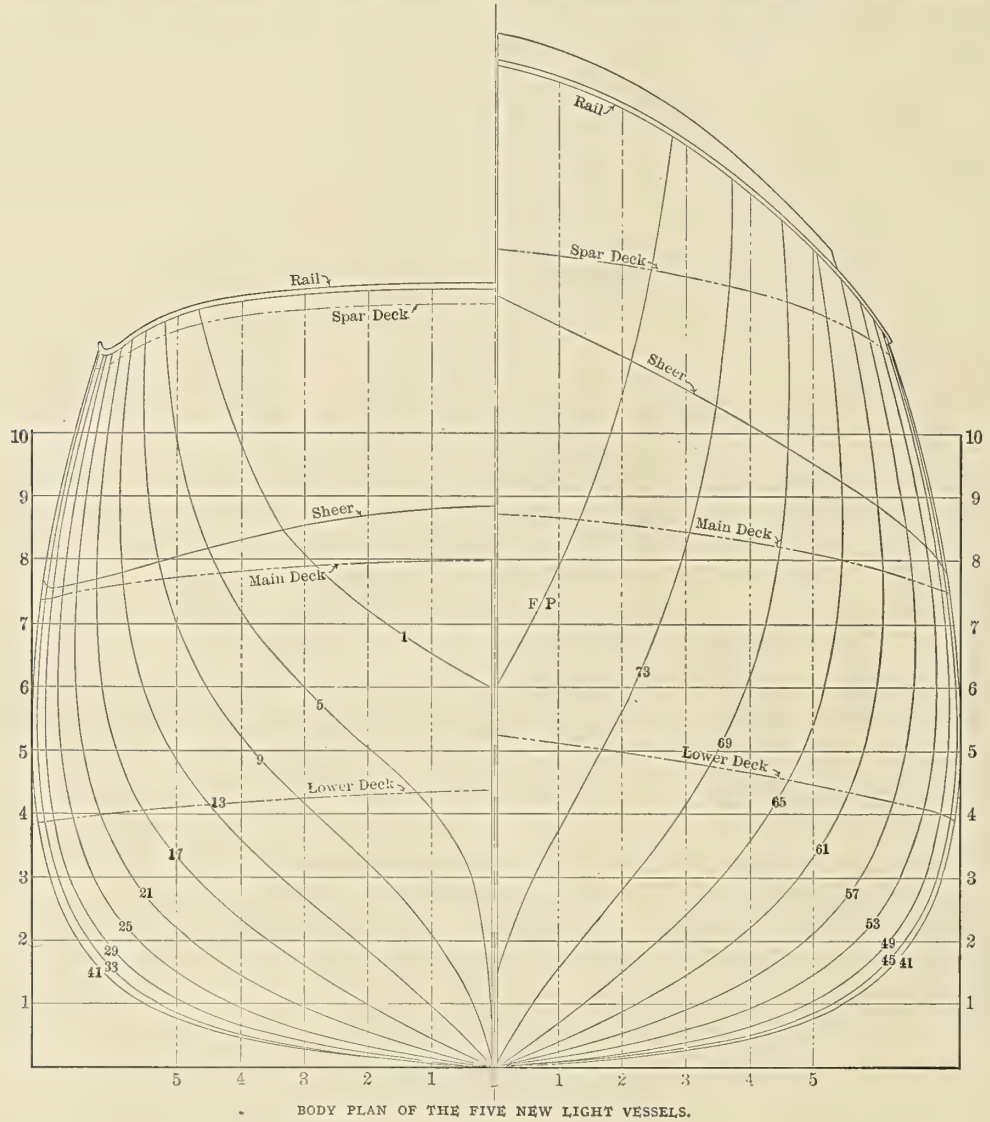
The keel is of the vertical bar type, 7 inches deep and 1⅝ inches thick. The stem is of forged steel, 6½ by 1⅞ inches, with the lower end connected to the keel. The stern frame and rudder post, including the connections to counter and keel, and the bosses for rudder stock and pintles, are made in one forging of wrought iron, with an eye for the stern tube worked in the stern post. The rudder post, stern post and keel connections are 6 inches wide, sided 3¼ inches. The lower end of the stern post extends into the vessel about 6 feet, and is scarfed to the bar keel. The rudder frame is of wrought iron forged in one piece, the minimum diameter of the rudder stock being 4⅝ inches, and of the pintles 2¾ inches. The weight of the rudder is taken by a collar secured to the rudder stock and turning on a brass ring fitted in a steel casting at the main deck. The side plates of the rudder are of 10-pound steel, backed with a tight filling of white pine and pitch.

The frames are numbered from aft forward, and spaced 18 inches apart. For one-half the vessel's length, amidships, they are 4 by 3½ by 7/16 inches. Forward, the frames measure 3½ by 3 by ⅜ inches, and aft, 3 by 3 by 5/16 inches. At the bow and stern heavier frames are introduced for additional strength. The frames extend alternately from the keel to the under side of the spar deck stringer plate and to the under side of the main deck stringer plate. At all bulkheads the frames are doubled by a 3 by 3 by 5/16-inch angle extending to the main deck stringer plate. A belt frame is fitted on each side of the vessel at frames 24, 33 and 41, constructed of 12½-pound plates, and stiffened on the inboard edge by two 2½ by 2½ by ¼-inch angles. The cant frames are 3½ by 3 by ⅜ inches, with inboard ends abutting

against the transom plate on the stern frame. Reverse frames measure 3½ by 2½ by 5/16 inches, and extend alternately to the lower edges of main deck beam brackets and well above the upper turn of the bilges. In the chain lockers and in engine and boiler spaces the reverse frames are doubled.

The center keelson consists of a vertical plate, 11 inches wide by 20 pounds, reduced at the ends to 17½ pounds. The horizontal foundation plate is 36 inches wide by 20 pounds, reduced to 17½ pounds. The rider plate is 6½ inches wide by 17½ pounds. The top and bottom angle bars are respectively 3 by 3 by 5/16 inches and 3½ by 3½ by ⅜ inches. One intercostal keelson is fitted on each side of the center line, with plates of vessel, with top plating 12½ pounds thick, and with beams 4 by 3 inches by 8½ pounds.

The foundation top plates for the engine are of 30-pound steel, lightened by holes. The angle connections are 3 by 3 by ⅜ inches, with angles 6 by 3½ by ½ inches for taking the holding down bolts. The saddles under each boiler are four in number, of 17½-pound plates, lightened by holes, and stiffened with double angles 3½ by 3 by ⅜ inches. These saddles are so located that every seam and rivet in the boilers can be conveniently calked, and every part of the bottom of the boilers is accessible for cleaning and painting. The foremast and mainmast are stepped each in an angle ring, 3½ by 3 by ⅜ inches,



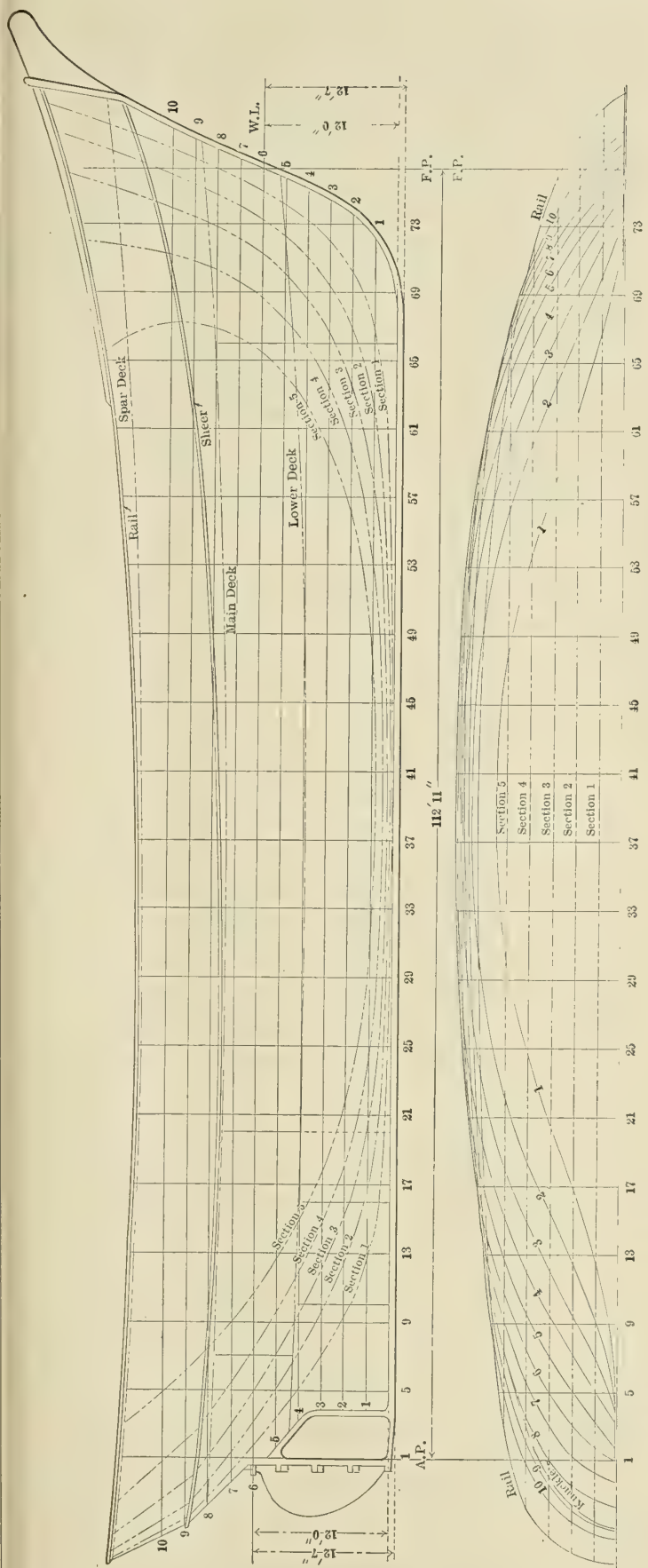
BODY PLAN OF THE FIVE NEW LIGHT VESSELS.

sufficient height to take the 7 by 3½ by 11/32-inch bulb angle and the 3½ by 3 by ⅜-inch angle on top of the reverse frames. The plates are of 15-pound steel for three-fifths the vessel's length, reduced gradually to 12½ pounds. The bilge keelsons consist of a 7 by 3 by 11/32-inch bulb angle and an angle bar, 3½ by 3 by ⅜ inches, riveted back to back and to the reverse frames. These keelsons extend as far as practicable into the ends of the vessel, and are carried continuously through the watertight bulkheads.

The floor plates are in one length from bilge to bilge, being 19 inches deep at the center line, and so tapered that at the lower turn of the bilge the depth is 9½ inches. They are made of 15-pound steel, except under the engine, thrust block and boilers, where the thickness is 17½ pounds. Under the engine and thrust block the depth is increased to fit the engine foundation. Limber holes, 2½ inches in diameter, are cut through the floors. Trimming tanks are located at the forward and after ends of located on a foundation plate riveted on top of the center line keelson.

The main deck beams are bulb angles, 8 by 3½ by 13/32 inches, reduced in size at the ends, with heavier beams under the steam windlass and at hatches. The crown of the beams is ¼ inch per foot of length. The ends of the beams are riveted to plate brackets of 20-pound steel, 20 inches deep, the brackets being riveted to the frames. The lower deck beams are angles 6 by 3½ by ½ inches, without crown, and fastened to the frames and to the lower deck stringer plates by brackets 15 inches deep, of 15-pound steel. The spar deck beams consist of 6 by 3 by ⅜-inch bulb angles, fitted on alternate frames. They have welded ends of a depth of 15 inches. The crown is ¼ inch per foot of length of beam.

The main deck stringers extend all around the sides of the vessel and fit close against the shell plating. They are 30 inches



WATERLINES AND BUTTOCK LINES.

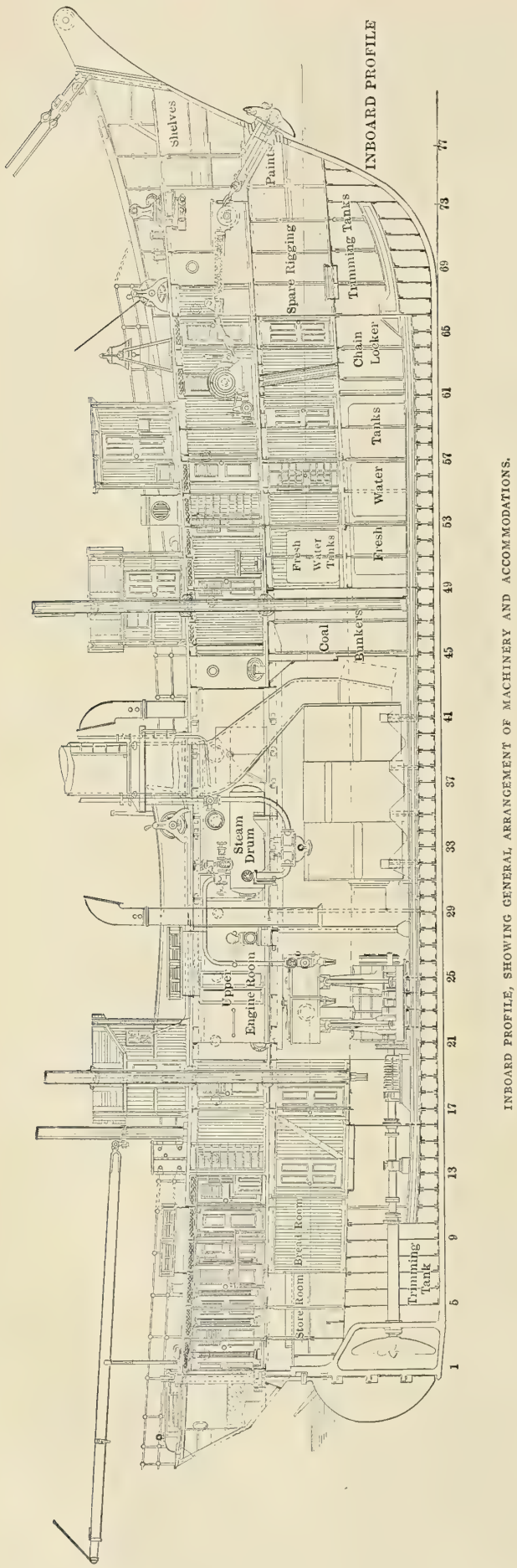
wide, and for half the length amidships are of 17½-pound steel, reduced to 15 pounds at the ends. They are fastened to the sheer strake by angles 3 by 3 by ⅜ inches. The outer and inner angles of the waterway are respectively 3 by 3 by 5/16 inches and 3 by 2½ by 5/16 inches. The lower deck stringer is continuous, except at the belt frames, to which it is connected with 3 by 3 by ⅜-inch double angles. This stringer is 15 inches wide and 20 pounds thick through the engine and boiler spaces, and 18 inches wide by 15 pounds thick elsewhere. The angles connecting the stringer to the shell plating are 3 by 2½ by ¼ inches. These stringers and their continuous angles pass through the watertight bulkheads, to which they are secured by double angle bars, 3 by 3 by ⅜ inches. The spar deck stringer plate is 21 inches wide and of 15-pound steel amidships, reduced at the ends to 12½ pounds. It is connected to the shell plating by angles, 3 by 3 by 5/16 inches. The inboard angle, forming a waterway and extending from stem to stern, is 2½ by 2½ by 5/16 inches.

The main deck tie plates are 24 inches wide and 15 pounds thick, and extend from the stringer plates forward to the stringer plates aft. There are extra tie plates at openings in the deck. Diagonal tie plates, 24 inches by 15 pounds, radiate from the mast partner plates. The lower deck tie plates are 15 inches by 12½ pounds. The spar deck tie plates are 12 inches by 10 pounds, with diagonals 15 inches wide. Breast hooks are fitted above the spar deck forward; midway between spar and main deck forward; midway between main and lower deck forward; and midway between main and lower deck aft. The lower deck stringer plate ends in breast hooks forward and aft.

Watertight bulkheads are fitted on frames 7, 10, 16, 20, 49 and 66, the latter being the forward collision bulkhead. The after watertight flat extends from frame 10 to the stern post. From frame 16 to frame 20, at the height of the lower deck beams, is a watertight flat connecting the two bulkheads, and with watertight sides forming the thrust bearing recess. The after collision bulkhead is formed by the horizontal watertight flat, the floor on frame 10 and the upper bulkhead on frame 7. The bulkhead plating is laid in horizontal strakes, the lower half being of 12½-pound steel, and the upper half of 10-pound steel. The bulkheads are stiffened by vertical bars spaced 24 inches apart on one side, and horizontal bars 48 inches apart on the other, in each case of 3½ by 3 by ⅜-inch angles. The coal bunker bulkheads are of the same weight as the watertight bulkheads, and are stiffened by 3½ by 3 by 5/16-inch angles, 24 inches apart.

The shell plating is fitted in inside and outside strakes. The sheer strake is 42 inches wide, of 20-pound steel amidships, reduced at the ends to 17½ pounds. The garboard strake is 36 inches by 18 pounds, reduced to 15 pounds. The plating between main and spar decks is 12½ pounds. Plates around the propeller boss and the hawse pipe openings are increased ⅛-inch in thickness. Bilge keels, extending for about 60 feet in length on each side of the vessel, and run in a line conforming as nearly as practicable to the flow of the water when the vessel is going ahead, project 18 inches from the sides, and are constructed of 12½-pound plates and 3 by 3 by 7/16-inch angles, with a lining bar 3 by ¾-inch flat steel. The inside of the bilge keels is filled in solid with yellow pine and pitch.

The stanchions in the hold are of pipe 3 inches in diameter, with solid forged feet and heads. One is fitted under each alternate beam, with extra stanchions under the windlass and other heavy weights. A stanchion formed by two channel bars riveted back to back is fitted under deck beam 28, and the operating gear for the coal car is attached to it. On frame 45 are two extra heavy stanchions, to support the weight of the wing bunkers and the fore-and-aft girders. Stanchions under the spar deck are of 2½-inch pipe, with solid forged heads and feet welded to the pipe. The bulwarks on the spar deck forward are supported by forged wrought iron stanchions 2 inches in diameter and 36 inches apart, riveted through palms to the horizontal flange and the inboard waterway angle, to the bulwark plating, and to the 5 by 3½ by ⅜-inch rail angle. The sheer molding on spar deck is a 2 by 1-inch half-round bar riveted at top edge of the spar



INBOARD PROFILE, SHOWING GENERAL ARRANGEMENT OF MACHINERY AND ACCOMMODATIONS.

deck sheer stringer. The main deck molding is 2½ by 1¼-inch half-round. The spar deck rail runs all around the vessel, and is fitted on stanchions 3 feet in height, and 3 feet 6 inches apart. Fore-and-aft rail pipes are ¾ inch in diameter. Awning stanchions are fitted around the spar deck at alternate rail stanchions.

There is one hawse pipe in the center of the stem, measuring 15 inches in inside diameter. The tube and its flanges are of cast steel, the thickness being 3 inches at the top and 5 inches at the bottom. A cast steel hawse pipe is fitted on the starboard side of the vessel, with proper reinforcement by extra frames and plates. The bottom plates of the vessel inside to well up the curve of the bilges are coated with a mixture of one part Portland cement and two parts of fine fresh-water sand.

The main deck planking is of white pine 3 inches thick and 4½ inches wide, fastened with ⅝-inch galvanized iron bolts. The deck is tightly calked with two threads of oakum and one of cotton. The plank sheer is of Georgia pine, 3 inches thick and 9 inches wide. The spar deck plank sheer and planking are the same as on the main deck. The entire spar deck is covered with No. 4 canvas laid upon heavy straw paper freshly painted. The lower deck planks measure in section 2½ inches by 5 inches. The holds at the sides forward and aft are fitted with yellow pine battens or "hold sparring," 1½ by 4 inches, bolted to the reverse bars and readily removable. The coal bunkers are sealed dust-tight up to the ends of the reverse frames at the upper turn of the bilge, where a tight sloping ceiling is fitted in two thicknesses of 1 inch each, between the frames and against the shell plating.

(To be concluded.)

New Steamship Lines.

A new line has been planned from Christiania, Norway, touching at one or more Norwegian ports and at an English or continental port, thence to Cuba, Mexico and Galveston, Texas. On the return trip the ships would touch at Norfolk, Va. By using the port of Coatzacoalcos, Mexico, which is connected by railroad with Salina Cruz on the Pacific, Norway would thus obtain convenient connection with the Pacific coast of Mexico, Central America and Peru. It is proposed as a beginning to employ two steamers, each of 5,500 tons dead weight carrying capacity, and costing about $400,000 (£82,200). The trip would occupy about six weeks. An annual subvention of $26,800 (£5,500), for three years, is expected.

It is proposed to establish a weekly service of 17-knot steamers between Killery, on the west coast of Ireland, and Green Bay, on the east coast of Newfoundland, in order to shorten the transatlantic steamship route. Passengers and mails would make a two-hour journey across Newfoundland, and would then reach Gaspe, Quebec, by a 20-knot steamer. From that point they would proceed by train to any part of the western continent. The scheme also provides for an alternative tunnel under the straits of Belleisle, in order to effect connection with the proposed Canadian railway along the coast of Labrador. Either method of connection, it is said, would insure a saving of about thirty-two hours as compared with other Atlantic routes. The colony of Newfoundland is prepared to pay an annual subsidy of $75,000 (£15,400) for twenty-five years.

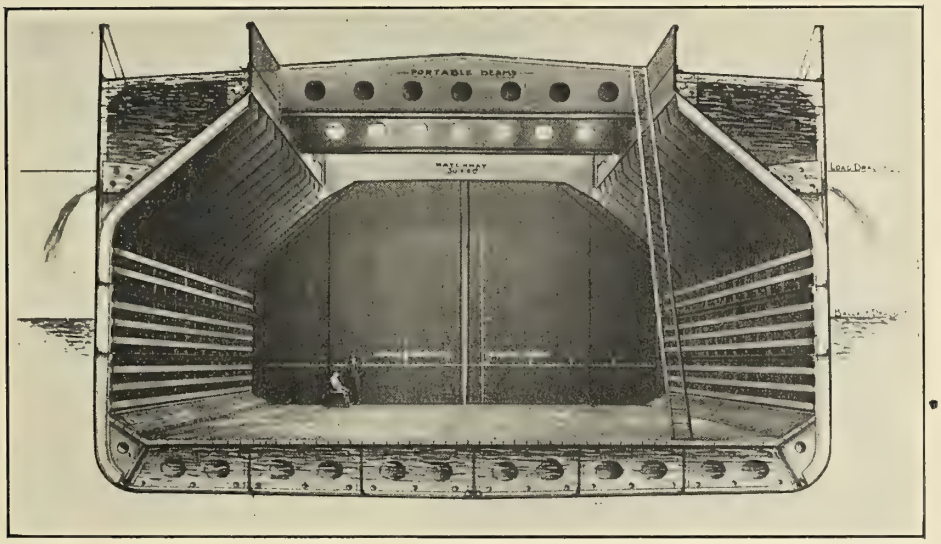
A new steamship company is being inaugurated to conduct mail service between Great Britain and Australia. The total capital required is $17,150,000 (£3,525,000), of which the Australian commonwealth is to guarantee a debenture issue of $6,250,000 (£1,285,000).

The Japanese steamship company Osaka Shosen Kaisha, which has a large fleet in the Formosan trade, has just added a new 3,000-ton steamer of 21 knots to maintain a rapid service between Japan and Formosa. The present trip from Kobe occupies five days. It is expected that the new ship will reduce this

to three days, the distance being about 1,500 nautical miles.

The Japanese government is considering a number of subsidy schemes for increasing the operations of the Japanese merchant marine. For services in the Japan Sea, the amount provided for is $175,000 (£36,000) per annum for two vessels direct to Vladivostok, one smaller vessel to Vladivostok by way of intermediate ports, and a still smaller ship to Saghalien. For the Shanghai line, six vessels are called for. For the North China line, six are required, and one to Korea. For service upon the Yangtse river, steamers are required of an aggregate of 27,000 tons, making nine monthly trips between Shanghai and Hankow, and six trips per month during the winter. A number of other services are also under contemplation.

THE STEAMSHIP BORGESTAD, FITTED WITH CANTILEVER FRAMING.



SECTION SHOWING CANTILEVER FRAMING FOR BULK CARGO VESSELS.

A New Type of Ocean Freight Steamer.

One of the latest and most up-to-date freight steamers, especially for the trade in which she is to be employed, is the *Borgestad*, which has recently taken up her work under charter of the Dominion Coal Company, Sydney, Nova Scotia, for their coal trade between that port and Montreal.

She has been built by Sir Raylton Dixon & Company, Limited, of Middlesbrough, to the order of the Statsraad Gunnar Knudsen, of Porsgrund, Norway, for the Aktieselskabet Borgestad.

Her leading dimensions are 372 feet long over all, 51 feet beam and 29 feet deep, and she carries over 7,000 tons of coal on a draft of 23 feet 1 inch, at an average speed of over 11 knots. She steams above 12 knots when light.

Her most remarkable feature is that she is a perfect self-trimmer, no coal trimmers being required, either in loading or discharging, which is done at the rate of 1,000 tons per hour. For the return voyage she is provided with 75 percent more water ballast than usual, which is carried in tanks at each side of the holds under the deck, and so incorporated with the frames as to add immensely to the longitudinal strength of the ship.

In outward appearance she very much resembles the large freight steamers on the Great Lakes, having her engines placed right aft, and very wide hatchways. The strongest type of vessel afloat on light draft, this cantilever system is an ideal one for the Lake service, and the immense capacity of the ship is suitable for either grain, iron ore, coal, timber or wood pulp.

Her rig and general appearance are extraordinary, for she has no masts, and is fitted with ten derrick posts in pairs, which, although not required in the owner's trade on the St. Lawrence, will be necessary in general trades in which she will be employed during the winter.

This type is classed by all of the classification societies, Lloyds, British Corporation, Veritas and Norwegian Veritas, to the rules of the last of which the *Borgestad* has been built, under special survey.

Her engines were built by the North Eastern Marine Company, at Sunderland, and have cylinders 26, 42 and 70 inches in diameter by 48 inches stroke. Two boilers of 180 pounds pressure, 15 feet diameter by 11 feet 6 inches long, and one 11 feet diameter by 10 feet 6 inches long, fitted with Howden's forced draft, will provide steam for 2,200 indicated horsepower.

A New Canadian Liner.

BY BENJAMIN TAYLOR.

An addition to the fleet of Donaldson Brothers, Glasgow, who have for many years run a service of cargo steamers between the Clyde and Liverpool and Canada, and who have lately been adapting their service to passenger traffic also, is the *Cassandra,* which has been launched by Scott's Shipbuilding & Engineering Company, Greenock. This is the first steamer the firm has had built specially for the passenger trade. The *Athenia* has second and third-class accommodation, which was fitted after she had been in service, and she has been hitherto their only passenger steamer.

The *Cassandra* is intended for the passenger and cargo trade between Glasgow and Canadian ports. She will carry only second and third-class passengers. The second-class passengers will have all the best parts of the ship usually reserved for first class. The vessel is a twin screw steamer, 455 feet in length, 53 feet in breadth, 40 feet in depth to shelter deck, and of 8,000 tons gross. She is of the shelter deck type, and has a long upper bridge on the shelter deck, with a boat deck above.

She is fitted with twin screw triple expansion engines. The cylinder diameters are 26, 42 and 70 inches, respectively, with a stroke of 4 feet. The bedplates and framing are massive castings, well secured by fitted bolts, both to the cylinders and to the tank top. The shafting throughout is half an inch in excess of the diameter required by Lloyd's rules.

The propellers are 16 feet 6 inches diameter, and have cast iron bosses fitted with cast steel blades. The surface condensers are cylindrical with large cooling surface, built of steel plates, and supported on the wing columns. Steam is supplied by two single and two double-ended boilers working under natural draft at 180 pounds pressure. They are 15 feet 9 inches in diameter, and 11 feet 6 inches and 20 feet long, respectively. There are 18 furnaces, and one double funnel 14 feet in diameter, with a height of 90 feet above the grate. The engines are designed to give a speed of 15 knots at sea, with 5,500 horsepower and 88 revolutions per minute.

Accommodation for 200 second-class passengers is provided on the shelter, bridge and boat decks. The saloon is on the shelter deck amidships, and extends the full width of the ship. It is handsomely decorated and paneled in polished oak and mahogany, and is lighted by large sidelights from above, and by a well passing through the music saloon to the flying bridge deck, where it is surmounted by a teak skylight filled with stained glass. The music room is immediately above the saloon, and is a handsome apartment finished in white enamel. A large smoke-room is fitted at the after end of the bridge deck, with sofas, chairs and marble top tables. The staterooms are large, and each is fitted with folding iron beds and sofa.

Accommodation is also provided for about 1,000 third-class passengers, whose berths are arranged in rooms, and are of galvanized iron. These rooms, and also the other apartments designed for the use of steerage passengers, are in accordance with modern practice and comforts. A recreation room for their use is also provided.

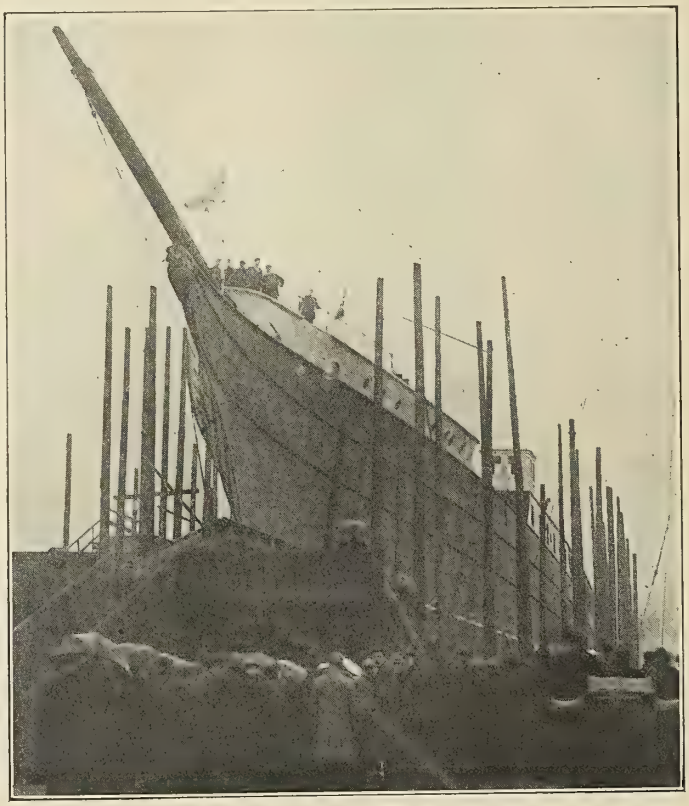
This vessel is primarily intended for passengers, but she is also completely equipped for carrying cargo. The holds are five in number, and provide stowage for 9,000 tons of deadweight. The loading and discharging arrangements consist of ten derricks and ten steam winches. For the transport of frozen meat and dairy produce from Canada a large refrigerating chamber with a CO_2 machine, built by J. & E. Hall of Dartford and London, is fitted in the lower 'tween decks; also a chamber for provisions for passengers' use.

Two sets of plant for electric light are supplied, each capable of maintaining the entire installation. The cooking apparatus is very complete, and separate galleys are fitted for second-class passengers, third-class and crew.

The New English Royal Yacht.

King Edward's new yacht is a private vessel, though her construction has been superintended by the Admiralty. She is a triple screw turbine vessel and was christened *Alexandra* as she was launched on May 30 from the yard of A. & J. Inglis, Limited, Pointhouse, Glasgow. The new yacht is a steel vessel of 2,050 tons displacement, 4,500 indicated horsepower and of 18 knots speed. She is 300 feet in length over all, 40 feet in breadth and 23 feet deep to the upper deck. She is built with a topgallant forecastle and a bridge deck 150 feet long, extending to the sides of the ship, carried on stanchions from the main rail in the way of the pavilion or deckhouse. Her draft is to be 12 feet 6 inches.

The pavilion contains the reception room, dining-room and



BOW VIEW OF THE ALEXANDRA ON THE STOCKS.
(Photograph, Lafayette, Glasgow.)

pantry. Abreast of it there are two small boudoirs, from which is a clear view ahead and astern over each side. The king's smoking room is under the bridge, also rooms for the commander and officers, and the ship's hospital. A stairway gives access to the bridge or promenade deck. On the main deck, abaft the turbine room, are the royal apartments, and rooms for the king's secretary, equerries and others.

The cabin servants are berthed aft on the main deck; the warrant officers abreast of the funnel hatch; the kitchen comes immediately in front of the boiler space; and next come the ward room and officers' cabins; while forward of all these is the crew space. The forecastle contains the crew's galley, lamp room, and lavatories for seamen and firemen. On the lower deck is additional crew space, auxiliary machinery, and various store rooms, magazine and baggage rooms.

The vessel is rigged as a three-masted schooner, and has two funnels. She will be propelled by three sets of Parsons turbines driving three separate shafts and supplied with steam by three Yarrow boilers. The new yacht, which will replace the *Osborne,* now no longer fit for service, is 137 feet shorter than the *Victoria and Albert,* and of less than half the tonnage. She is the first royal yacht built specially for turbine machinery. The

THE BRITISH ROYAL YACHT ALEXANDRA ENTERING THE WATERS OF THE CLYDE.
(Photograph, Allan McPherson.)

only other royal turbine yacht is the *Mahroussa,* from which Messrs. Inglis took out the reciprocating engines in favor of turbines last year for the khedive of Egypt.

The *Alexandra* is the first royal yacht ever built in a private establishment, and the builders have a feeling of elation that they were chosen for this important contract. Skill in shipbuilding is pretty common in Great Britain, but not every shipbuilder has directed his attention to designing and building large steam yachts.

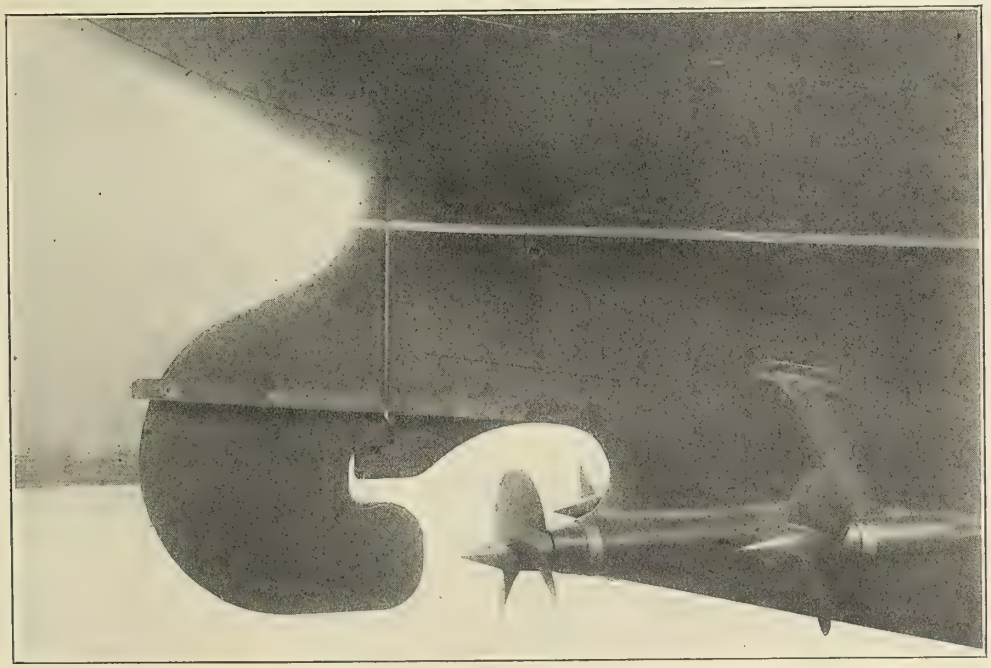
The turbines are arranged one high-pressure amidships, and two low-pressure on the sides, with reversing turbines attached to the exhaust casing of each of the low-pressure turbines. All the bearings are under forced lubrication, with sight-connections to observe the flow of oil. An independent oil-cooler is provided. The Parsons patent vacuum augmentor arrangements are fitted to maintain a high vacuum. Starting platform and operating valves are on a level with the turbines. There is one valve for starting, and the maneuvering valves are so combined as to be operated by one handle.

Condensing water is circulated through the two condensers by two large centrifugal pumps worked by independent engines. The twin air pumps are also independent. Dry air pumps are worked from the circulating engine. A feed filter and a feed heater are installed in the engine room. The three Yarrow boilers are designed for a working pressure of 150 pounds per square inch.

Old British Warships Sold.

A few weeks ago one of the periodic house-cleaning sales of the British navy took place in Chatham dockyard. Under the conditions of the sale, the ships are not to be removed from the United Kingdom, and are to be completely broken up within two years. Four vessels were sold, bringing a total of £61,450 ($300,046). The original cost of the four amounted to £1,453,276 ($7,072,368).

The ships sold were the battleship *Sans Pareil* of 10,470 tons, built in 1887 at the Thames Iron Works; the third class battleship *Conqueror* of 6,200 tons, built at Chatham in 1881; the armored cruiser *Undaunted* of 5,600 tons, built by Palmers' Shipbuilding Company in 1889, and the torpedo gunboat *Alarm* of 810 tons, built at Sheerness in 1892. The *Sans Pareil* will be recognized as the surviving sister of the ill-fated *Victoria,* which was sunk in collision with the *Camperdown* in 1893.



STERN OF THE ALEXANDRA BEFORE LAUNCHING, SHOWING THREE PROPELLERS.
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INTERNATIONAL MARINE ENGINEERING

Published Monthly at
Christopher St., Finsbury Square, London, E. C.
E. J. P. BENN, Director and Publisher
and at
17 Battery Place - - - NEW YORK
By MARINE ENGINEERING, INCORPORATED
H. L. ALDRICH, President and Treasurer
GEORGE SLATE, Vice-President
E. L. SUMNER, Secretary
SIDNEY GRAVES KOON, Editor

Branch Offices { Philadelphia, Machinery Dept., The Bourse, S. W. Anness.
Boston, 170 Summer St., S. I. Carpenter.
Chicago, 625 Monadnock Block, Howard S. Moss.
Midlands, 2 Sandhurst Road, Moseley, E. E. Starke.

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The Coming of the Lusitania.

Before the next issue of this publication reaches our readers, the new Cunard steamship *Lusitania* will have made her initial round trip from Liverpool to New York and back. It is interesting in this connection to note that what has made possible the placing in service of the splendid ships which have recently been added to the merchant marine of Great Britain and Germany has been an increasing ability and willingness on the part of the traveling public to pay large and ever larger prices for the conveniences and speeds now offered on the Atlantic ferry. It is safe to state that the average price of passage on the best and fastest ships of the present day (counting first cabin only) is at least double the corresponding figures for the best and fastest ships of twenty years ago.

The era of the modern high speed trans-atlantic liner may be stated to have had its inception in the famous *City of Paris* of the Inman Line, which ship was later known as the *Paris* and is now the *Philadelphia* of the American Line. The most representative example of the highest practice of the present day is naturally the Cunarder *Lusitania,* and strangely enough, or possibly not so strangely, both are products of the same shipbuilding establishment, that of John Brown & Company, Limited, (formerly J. & G. Thomson, Limited), at Clydebank, a little below Glasgow. The *City of Paris* was the first vessel to bring the time of passage across the Atlantic below six days, and it is safe to assume that the *Lusitania* will be the first to bring it below five days, unless perchance her sister ship, *Mauretania,* should steal a march on her.

The *City of Paris,* or more properly the *Philadelphia,* was placed in service in 1889 between Liverpool and New York, and has since been placed on the Southampton service. She measures 528 feet between perpendiculars, and has a beam of 63 feet and a depth of 39 feet. The net and gross tonnages are respectively 4,578 and 10,786. She was the first of the large twin screw passenger steamers to cross the Atlantic, and thus is notable in more ways than merely on account of being a record breaker in speed. As compared with these figures the *Lusitania,* which will be placed in service in September of this year, measures 760 feet between perpendiculars, with a beam of 88 feet and a depth of 60 feet 6 inches. The gross tonnage is 32,500 and the load draft 33 feet.

The propulsion of the *Philadelphia* is accomplished by means of twin screws actuated by quadruple expansion engines, developing a total of about 20,000 indicated horsepower. The cylinder diameters are respectively 38½, 54, 76, and 106 inches, with a common stroke of 60 inches. The revolutions are about 89 per minute. Steam is furnished at a pressure of 206 pounds per square inch by six double-ended and four single-ended Scotch boilers. The *Lusitania* is propelled by four screws, and she will be the first merchant vessel so propelled to cross the Atlantic. These screws are actuated by steam turbines of the Parsons type, with an estimated aggregate of about 68,000 shaft horsepower at 140 revolutions per minute. Steam is furnished, as in the case of the smaller vessel, by Scotch cylindrical boilers, twenty-five in number as against the previous ten. The boilers of the *Lusitania* are considerably larger than those of the *Philadelphia,* the total number of furnaces being 192 as compared with 64. As a result of these differences in the power of the machinery, the speed of the *Lusitania* will be 25 knots, as compared with 20 knots for the *Philadelphia.*

Of closer interest at present, however, is a race across the Atlantic, which is said to be impending between the *Lusitania* and the *Lucania* of the same line. The latter is a ship built in 1893 by Fairfield & Company, Limited, of Glasgow, and measures 601 feet between perpendiculars, with a beam of 65 feet and depth of 38 feet; her net tonnage is 4,975, and the gross tonnage, 12,952. This ship is propelled by twin screws actuated by two five-cylinder triple expansion engines, the cylinders being respectively 37, 37, 79, 98 and 98 inches in diameter, with a common stroke of 69 inches. It will be noted that there are two high-pressure cylinders, and two low-pressure cylinders. The total indicated horsepower is about 31,000 and the sea speed 22 knots.

It is proposed to start these vessels on a handicap race on September 7th, the *Lucania* leaving Liverpool at 4:30

P. M., followed at 7:00 o'clock by the *Lusitania*. Both will stop at Queenstown for mail and passengers, and the real race will begin from this point, and will not be ended until Sandy Hook is reached. The distance is about 2,750 nautical miles, and it will be the endeavor of the *Lusitania* to overcome the handicap of two and one half hours given to her rival. As the *Lucania* now holds the record from Queenstown, her time being five days, seven hours, and twenty-three minutes, a very pretty race should be the result. If, however, the *Lusitania* makes on this trip the same sort of speed which she made on her trial trip of one thousand miles—that is, 25.5 knots—she ought to show up the winner, by a margin of about ten hours. Neither ship has many vacancies in the passenger list, and intense interest is being taken in the event.

The Electric Propulsion of Ships.

We had occasion to refer, some months ago, to a scheme for propelling ships, or, to be more exact, river craft in the nature of shallow draft barges, by means of electric prime movers actuated by current supplied from what might be termed a central station. In another column of the present number will be found an article based upon one published a few months ago in an Italian contemporary, wherein are described installations which have actually been placed in service on the continent of Europe, one case cited having been on one of the Swiss lakes, while two others were on Russian rivers. At first sight it would appear that this scheme would involve an unnecessary complication of detail, and an equally unnecessary addition to machinery weights, because there is interposed between each engine and its corresponding propeller shaft an electric generator, an electric motor and in one type a magnetic clutch. This disadvantage in the way of complications and added weight is a very serious one, and, were it not for advantages which in a measure offset the disadvantages, the proposition would scarcely be tenable from any point of view.

The advantages, however, are very real, and are twofold in character. One has to do with the ease of control of the machinery as a whole, or rather, the ease of manipulation of the vessel by means of its own motive power. This is accomplished from the pilot house direct, instead of through the intermission of signals sent to the engine room. The other large advantage in this type of outfit lies in the possibility of utilizing for propulsion an engine which is not readily reversed, and which operates with best efficiency at a single pre-determined speed of revolution. There would be no special advantage in using this engine, as compared with any other engine, were it not for the fact that its ultimate efficiency is extremely high—probably three times as high as that of the ordinary reciprocating steam engine—and that it can use fuel of a low grade and consequently low cost. This combination of low cost of fuel and extremely high economy in its use touches the commercial side of the question very deeply, and makes it feasible in some cases to install the outfit mentioned, in spite of the added cost and weight of the intermediate portions of the equipment.

In spite of the advantages of this system, however, it will doubtless find very slight use except in very special cases. Rather will attention be directed to improving the thermodynamic and mercantile efficiencies of some direct-acting form of prime mover, thus doing away with all necessity for intermediate apparatus. In this manner much the same results will be accomplished, but without the heavy financial and weight-carrying handicaps of that here outlined. And as to ease of control from the pilot house, it is possible that some form of electric or other control of the engines from that point may be developed, if the present almost universal system of signaling becomes in any way onerous.

In connection with the subject of propulsion, attention might be directed to the article beginning on page 352, where is described the propelling outfit of a large coasting schooner provided with an internal combustion engine for use against adverse winds, or in calms or light weather. A very satisfactory arrangement seems to have been developed, much like the "steam-schooners" of the American Pacific coast, but with the added ease of manipulation of the modern marine gas engine. The use of these engines in small units aboard this vessel has resulted in the provision of a source of electricity for lighting and small power purposes, making her a unique specimen of the schooner family. This is an installation which is easily fitted, even in vessels already built, and the system is sure to have an ever-widening use where the main reliance for propulsion is placed in sails, but where a little more certainty of operation on schedule is desired than is afforded by the unaided wind.

Combined Indicator Cards.

One of our correspondents has furnished us with some very interesting material in the shape of combined indicator cards taken from engines in actual service on merchant vessels. Little comment is necessary along the line of the importance of taking indicator cards at frequent intervals from all reciprocating steam engines, where a knowledge of the conditions of operation of the engine is considered desirable. The indicator card, as its name suggests, indicates what the engine is doing, not only with regard to the power developed, but also with regard to the action of the valves, the tightness of the piston rings, and various other items of comparatively lesser importance. To find out, however, just what an entire engine of the compound or multiple expansion type is doing, it is necessary to so combine these cards taken from the several cylinders, as to show the relation they bear to the continuous expansion of the steam from boiler pressure down to the vacuum maintained in the condenser. It is for this reason that the article beginning in the present number is important, bearing as it does upon the design of the engine, the relations between cylinder volumes, and the sizes of pipes and valve openings.

Progress of Naval Vessels.

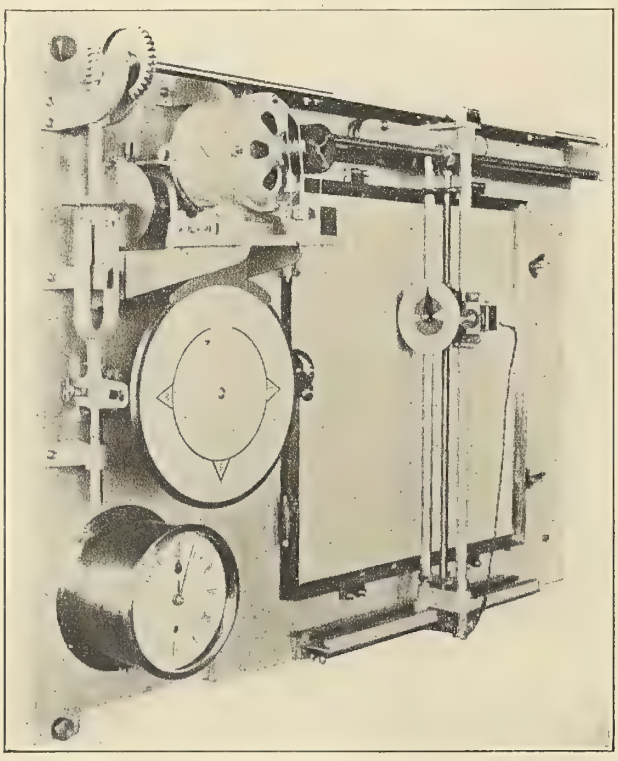
The Bureau of Construction and Repair, Navy Department, reports under date of July 10, 1907, the following percentage of completion of vessels building for the United States Navy:

	Tons	Knots		June 1	July 1
BATTLESHIPS.					
Mississippi	13,000	17	Wm. Cramp & Sons	87.47	88.96
Idaho	13,000	17	Wm. Cramp & Sons	79.9	81.98
New Hampshire	16,000	18	New York Shipbuilding Co.	72.5	75.4
South Carolina	16,000	18½	Wm. Cramp & Sons	14.57	17.48
Michigan	16,000	18½	New York Shipbuilding Co.	16.4	19.4
ARMORED CRUISERS.					
South Dakota	13,680	22	Union Iron Works	97.4	97.5
North Carolina	14,500	22	Newport News Co.	80.69	83.77
Montana	14,500	22	Newport News Co.	74.89	76.96
SCOUT CRUISERS.					
Chester	3,750	24	Bath Iron Works	78.6	81.26
Birmingham	3,750	24	Fore River Shipbuilding Co.	75.3	81.6
Salem	3,750	24	Fore River Shipbuilding Co.	77.0	80.8
SUBMARINE TORPEDO BOATS.					
Cuttlefish	—	—	Fore River Shipbuilding Co.	95.	97.
Viper	—	—	Fore River Shipbuilding Co.	92.6	95.
Tarantula	—	—	Fore River Shipbuilding Co.	95.	97.
Octopus	—	—	Fore River Shipbuilding Co.	93.	95.

ENGINEERING SPECIALTIES.

The Dead Reckoner.

This instrument, which is built by Siemens Brothers Dynamo Works, Ltd., of London, Woolwich and Stafford, consists of two parts, the transmitter, which is fixed on the poop, and the recorder, which is placed in the chart-room. These are connected by a small electric cable. The transmitter consists of an oblong cast iron box, 12 by 9 inches, with removable watertight



cover, carried on a base of suitable height. A shaft terminating in an eye projects from the after end of this box, and to this eye the rotator is connected by the usual log line. This shaft carries a worm which gears into a worm wheel driving one-half of a hunting switch. The other portion of the hunting switch is driven through suitable gearing by a small three-phase synchronous motor.

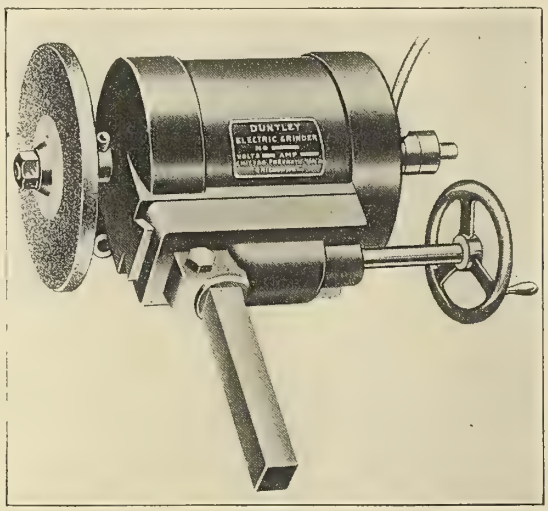
The recorder, which we illustrate, is mounted on a frame 40 by 30 inches, fixed vertically to a bulkhead, thus requiring no deck space. On this frame are carried two screw spindles at right angles to each other, one of which is termed the north spindle and the other the east spindle. The former is carried by a nut in which the east spindle works, and on a nut carried by the north spindle is fixed a time printing wheel. The construction is similar to that of an ordinary compound slide rest —the time wheel representing the tool. The north and east spindles are connected by suitable worm gearing to two steel disks, which are free to slide upon the shafts on which they work. These disks are placed at right angles to two other disks connected together, which are revolved through suitable gearing by a second synchronous motor.

The motor driving these two disks is connected in parallel with the motor on the transmitter, and being absolutely synchronous with it, imparts a motion to the disks directly proportional to the speed of the rotator. Therefore the travel of the timewheel will be directly proportional to the distance traversed by the ship, quite independently of the direction in which the timewheel travels.

Duntley Electric Grinders.

The line of portable electric tools built by the Chicago Pneumatic Tool Company, Chicago, Illinois, has been extended to include electric grinders. The design of these tools is such as will commend itself to those familiar with portable air tools, and their simplicity and economy are very marked. The tools are said to be exempt from frequent break-downs and are economical both as regards repairs and power.

The grinders are made in two distinct types, one for portable use and the other for use in machine tools, these latter being known as tool-post grinders. The portable grinders are made



in two sizes, taking 5-inch and 8-inch wheels respectively. They consist of a light motor of generous capacity, driving the emery wheel at the speed of the armature, which is so proportioned to the diameter of the wheel as to give the proper cutting speed recommended by the manufacturers of the best emery wheels. These tools are finding a wide field in all classes of metal work, the larger grinder being especially adapted for grinding rough castings, or whatever heavy duty is required.

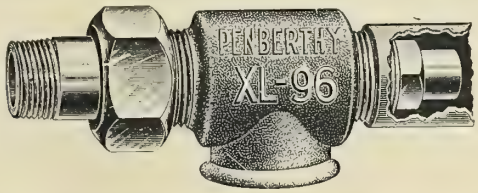
The tool-post grinders are made in three sizes, taking wheels of 5, 8 and 10 inches in diameter. The electrical parts have been designed along the same lines as the Duntley electric drill. The grinding arbor is of steel, and runs in bronze bearings which are self-lubricating. These grinders are provided with tapered steel bushings driven by the shaft and running in phosphor-bronze bearings fastened to the housing of the grinder. Any of these parts can be easily replaced, and no part of the motor housing itself is used as a bearing. The

grinders are provided with dust proof collars, keeping the emery out of the windings and bearings. The tools are light in weight, but they will develop a sufficient amount of power to do their work without excessive heating. They can be furnished especially adapted for internal grinding, or mounted on a pedestal if desired for stationary work.

Ejectors as Liquid Elevators and Conveyors.

There is a little machine known as an ejector, whose large field of usefulness is not yet appreciated by a great many users of steam. It is simple in construction, requires but a small amount of steam—far less than a steam pump—and on account of its compactness and portability, allowing it to be placed with little expense near the work to be done, is becoming a common substitute for steam pumps, siphons, etc.

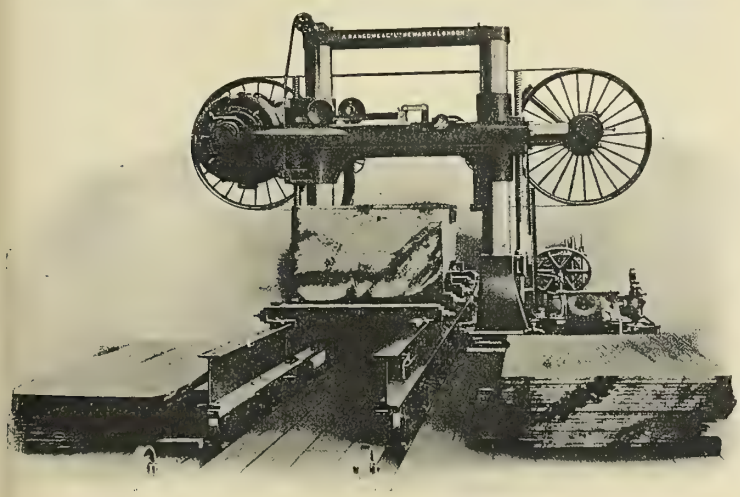
It would be difficult to enumerate all the uses to which an ejector is adapted, but when we say that anything and everything in the nature of a liquid (if not too thick) can be transported from one level to another, or horizontally any reasonable distance, the ground is just about covered. It is also an agency for raising liquids from wells, tanks, mines,



vessel holds, docks, etc. The manufacturers are the Penberthy Injector Company, Detroit, Mich.

A Patent Horizontal Log Band Saw.

The illustration represents a log band saw, developed for the use of shipbuilders and others, by A. Ransome & Co., Ltd., Newark and London. The driving of the saw is accomplished by an exceedingly simple, compact, and effective electrical drive, which not only obviates the necessity of the shafting, gearing, and belting required for machines driven from a line of shafting, but reduces by nearly one-half the floor space occupied.

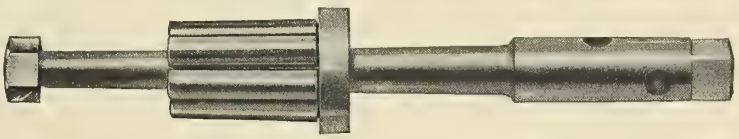


It also effects a considerable saving of power, and allows the machine to be fixed in any position that may be found most convenient, without regard to the position of the main shafting. The electric drive consists of a special type of motor, the armature of which is built around the shaft of the driving saw pulley, and hence the entire width of the machine is limited to that over which the saw pulleys extend. A small supplementary motor is added, for driving the friction gear which operates the traveling carriage, and the rising and falling motions of the saw carriage. The saws vary in width from 5½ to 9 inches, and are driven by pulleys revolving at from 315 to 440 revolutions per minute, in the different sizes.

In order to test the machine to its fullest capacity, two very old logs, one of elm and the other of oak, each being about 4 feet in diameter, were selected, the elm being sawn into 1-inch and the oak into ¾-inch boards. The trial, which occupied just 2½ hours, resulted in the production of 1,176 feet of elm and 1,512 feet of oak boards, the average rate of cutting being 81 feet a minute in the elm and 66 feet in the oak. Although both logs, being over 200 years old, were naturally very hard, all the boards produced were perfectly true and of uniform thickness throughout, and the surface was so smooth that it was difficult to trace any marks made by the saw. In order to test the accuracy of the cutting, a veneer of less than $\frac{1}{16}$ inch thick was sawn off the elm log; and although it was nearly 4 feet wide and 7 feet long, it did not vary perceptibly in thickness in any part. The machine was worked by one man and two laborers, the latter removing the sawn boards and assisting in fixing and turning the logs on the traveling carriage.

The Nicholson Boiler Tube Expander.

The Nicholson roller tube, self-feeding expander, manufactured by W. H. Nicholson & Company, Wilkesbarre, Pa., is



designed to be operated either by an air motor or by hand. The tool is composed of only nine separate parts, namely, a tapered mandrel, six rollers, a retaining collar and a nut. The heads of the rollers are spherical and fit into spherical bearings in the retaining collar, thus forming a ball and socket joint, which permits the rollers to work freely at an angle in either direction, thus making it possible to roll the tubes by turning the mandrel in either direction. The fact that the rollers are thrown at an angle when the mandrel is revolved makes the tool self-feeding, and, therefore, it requires no hammering or force to feed the tool into the work. After the tube is rolled, a few turns of the mandrel in the opposite direction immediately releases the expander. All parts are made from the best tool steel and are hardened throughout. It is claimed that the fact that six rollers are used insures a much tighter, quicker and smoother job than it is possible to obtain with an ordinary expander, and also that it may be done with less power.

TECHNICAL PUBLICATIONS.

A Manual of Marine Engineering. By A. E. Seaton. Size, 6¼ by 8¾ inches. Pages, 712 + 86. London, 1907: Charles Griffin & Co., Ltd., Price 21 shillings net. New York: D. Van Nostrand Co., Price $6.00.

This is the sixteenth edition of a work of which the first edition was published in 1883. This edition has been enlarged and partly rewritten from the fifteenth, the main point of departure being along the line of steam turbines. A short appendix on this subject has been added to the text, to supplement the information given in the fifteenth edition. This appendix starts with the statement that "the steam turbine is no longer in the experimental stage, so far as marine propulsion is concerned." A section is given of a Parsons turbine, and the mechanical efficiency is discussed to some extent.

Aside from this addition to former editions, the work may be stated to be an exceptionally valuable one upon the entire subject of marine engineering in all its phases, descriptions being given of various types of engines, boilers and auxiliaries, with profuse illustrations and diagrams. Tables are given where necessary to illustrate various points, and for reference.

Lloyd's Register of American Yachts. Size, 7 by 9 inches. pages 410. New York, 1907. Lloyd's Register of Shipping. Price $7.50.

The necessity for a yacht register has long been recognized, and the first of the type was issued in 1874 in New York. In the present book will be found listed the yachts belonging to the United States, the Dominion of Canada and the West Indies, this list covering no fewer than 3,489 names. Particulars are given of the type of construction, the rig, gross and net tonnage, sail area, length over all and on the waterline, extreme breadth, depth and draft, and of the machinery. The names are given of the sail maker, designer, builder, and engine builder, as well as the owner.

In addition to this very complete list of yachts is given a list of yacht clubs in the United States and Canada, with colored plates showing the burgees of the various clubs, and also plates showing in colors the private signals of various yachtsmen. These plates are 41 in number, and include upwards of 2,000 flags. Lists are given of signal letters, arranged in alphabetical order; of former names of yachts, whose names have been changed; a list showing names of yacht designers, yacht builders, engine builders, sail makers, and boiler makers of the United States and Canada, and an extensive list of yacht owners, giving in each case the address, the club, and the name and waterline length of yachts owned. The work is splendidly gotten up, and should prove exceedingly valuable for reference.

Steamship Inspection Rules Covering Boilers.

About a year ago a considerable flurry was manifested in boiler making circles by the announcement that the United States Steamboat Inspection Service had put into force a rule requiring that after June 30, 1906, all boilers subjected to a pressure of 160 pounds per square inch, or more, should have the tops of combustion chambers and back connections suspended from the top of the shell of the boiler. This precluded all possibility of using the familiar type of crown bar or bridge girder except in conjunction with stays to the shell; it being specifically required in the ruling that such girders should be suspended by braces, each of such braces to have a sectional area not less than twice the sectional area of each of the bolts suspending the top of combustion chambers from the girder. This ruling has now been repealed, and boilers may now be constructed with the crown bar or bridge girder as before.

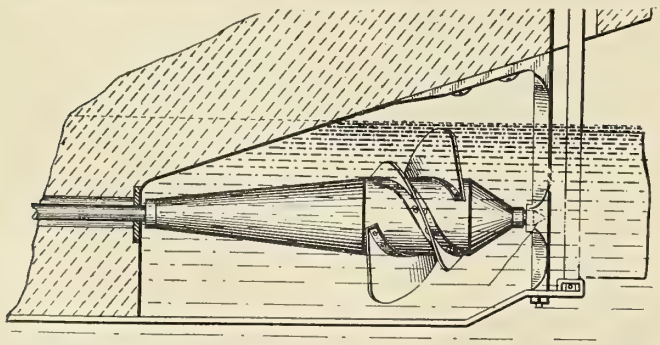
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

854,112. PROPELLER FOR VESSELS. HUGH R. SHAW, ROSSEAU, ONT., CANADA.

Claim.—The combination with a propelling shaft and stern post in which



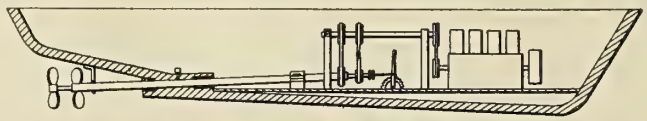
the rear end of such shaft is journaled provided with a suitable bearing to receive the end and formed with a knife edge above and below such bearing, of a solid propelling wheel having a central bore fitting the shaft, and provided with a conical front portion of comparatively long taper, a short cylindrical intermediate portion having spiral flanges affixed thereto, and a conical rear portion of a less length than the intermediate portion, both ends of the propelling wheel tapering down toward points in close proximity to the shaft and affixed thereto, and the bearings at both ends being likewise of substantially the same diameter as the reduced ends of the cone-shaped portions, whereby the churning of the water is avoided. One claim.

854,146. SUBMARINE BOAT. JOHN M. CAGE, DENVER, COL., ASSIGNOR OF ONE-HALF TO JAMES C. HARVEY, DENVER.

Claim 1.—In a submarine boat, a normally watertight shell comprising an operating room, fresh air and impure air chambers, means to compress air in the fresh air chamber, means to conduct air therefrom into the operating room, and means to exhaust the impure air from the latter into the foul air chamber. Twelve claims.

854,685. PROPELLER. JOHN BERMES, UNION, N. J., ASSIGNOR OF ONE-FOURTH TO DANIEL CROSSLEY, UNION, N. J.

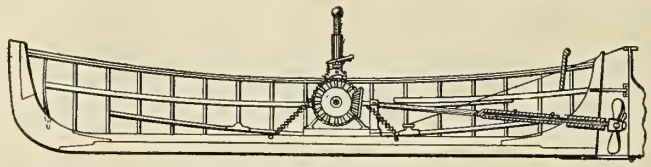
Abstract.—The invention consists in an improved arrangement of two propellers, one in advance of the other, and means whereby said propellers



may be rotated in opposite directions, so that the volume of water set in motion by the first propeller shall impact against the second propeller, which will thus operate to propel the vessel with which it is connected, at greatly accelerated speed. Two claims.

855,062. BOAT. WALLACE KIRKPATRICK, SAVAGE, MINN.

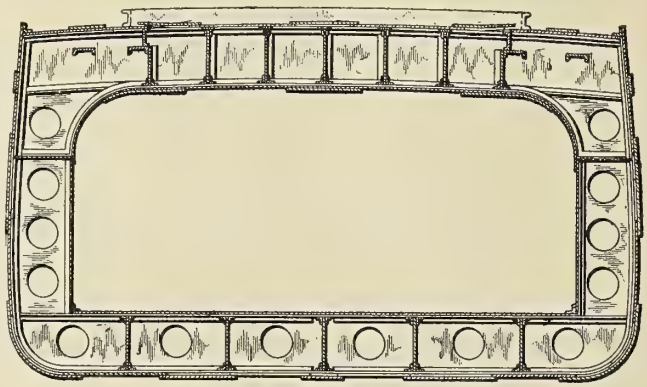
Claim 1.—In a boat propelling mechanism, a propeller shaft, opposing gears arranged to act alternately on opposite sides of said shaft to revolve it, two annular rows of ratchet teeth carried by each of said gears, the teeth in the two rows on each gear projecting in opposite directions,



an operating lever, two double pawls, each having a weighted end to normally engage one of the annular rows of ratchet teeth on one of said gears and a reduced end to engage the other annular row of ratchet teeth on the same gear, and means for elevating and supporting the weighted ends of said pawls to hold their reduced ends in yieldable engagement with their co-acting rows of ratchet teeth. Six claims.

855,154. SHIP CONSTRUCTION. WASHINGTON IRVING BABCOCK, NEW YORK.

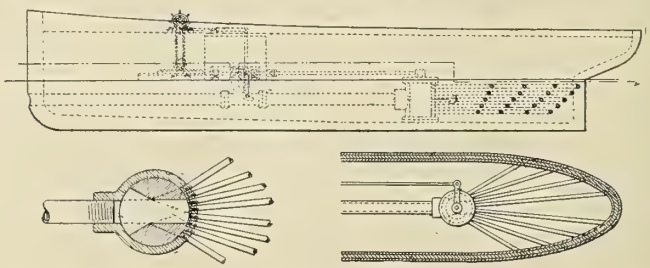
Claim 1.—In a decked ship having hatches extending across the center line and without stanchions, the combination of deep frames between the hatches, and a beam of substantially uniform depth between the hatch



lines across the top of each deep frame, the lower flange of said beam being braced to the deck at or near the hatch lines to prevent sidewise motion. Eight claims.

855,165. DEVICE FOR PROPELLING AND STEERING VESSELS. WILLIAM O. CUTTER, NATICK, MASS.

Claim 1.—In combination, a vessel, a water pipe extending longitudinally of the hull beneath the waterline and opening at one end thereof out of the bow of said vessel, a cock consisting of a casing provided with

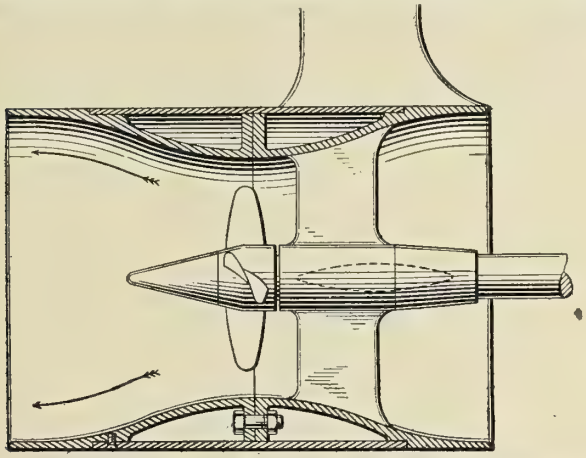


an inlet orifice connected to the other end of said pipe, and a rotatable plug provided with a passage extending therethrough having sides diverging adjacent to the inlet orifice of said casing, a plurality of outlet pipes leading from said cock to the stern of said vessel, an ejector having its

inlet and outlet orifices connected to said pipe between said cock and bow, and a receptacle for fluid under pressure connected to the intermediate orifice of said ejector. Two claims.

856,115. MARINE PROPULSION. YASUZO WADAGAKI, SASEBO, JAPAN.

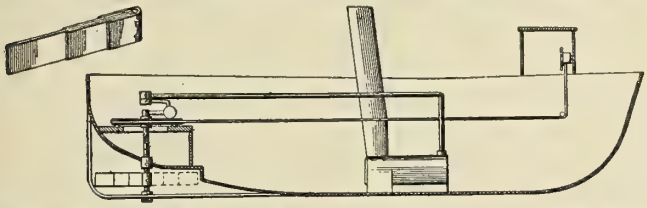
Abstract.—One object of the invention is to provide a propeller with a casing or jacket which will accelerate the feed of the water and confine it around the propeller, so as to prevent the tendency of the formation



of a vacuum around the hub of the propeller, and to prevent the force intended for propulsion from being wasted in centrifugal effect or in radially or tangentially agitating the surrounding water. Two claims.

856,338. MEANS FOR PROPELLING AND STEERING VESSELS. ALBERT L. CROSBY, PORTLAND, OREGON.

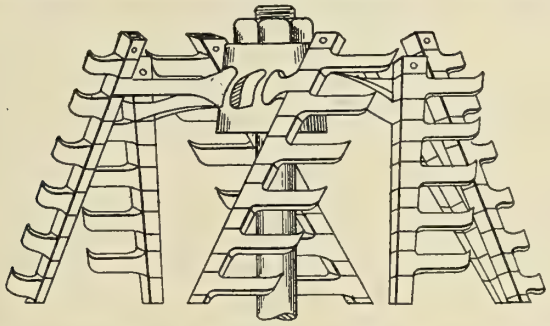
Claim 1.—The combination with a vibratory propeller shaft, and a propeller carried thereby, of a shiftable motor, connection between the



shaft and the motor to cause the motor to vibrate the shaft and to shift the shaft with the motor and steering mechanism connected to the motor to shift it and consequently steer the vessel. Six claims.

856,487. DREDGER-CUTTER. JOHN F. OLLRICH, SAN FRANCISCO, CAL.

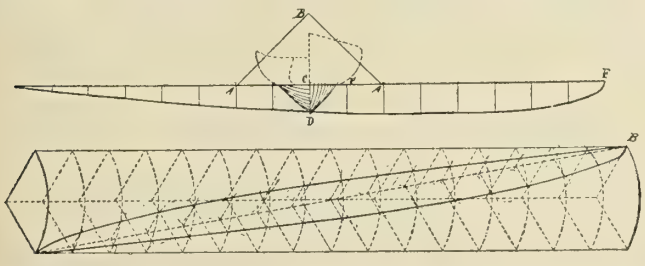
Claim 1.—A cutter head comprising a shaft, a hub thereon, arms or spokes radiating from said hub, bars extending from the ends of said arms or spokes in planes oblique to that through the shaft and cutting



device having parts formed integral therewith and resting over and in contact with opposite sides of the bar to protect the same from wear. Five claims.

856,745. MODELING FOR SPEED-BOATS. JOHN F. TWIGG, SAN FRANCISCO, CAL.

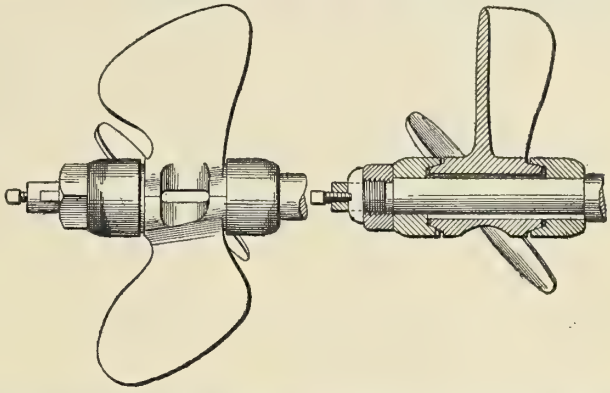
Claim 3.—In a boat or vessel, an under water body formed by intersections of a chord of a quarter of a circle having a radius of approximately 2.75 times the half breadth of the boat amidships, with equally spaced



horizontal and vertical lines intersecting each other and the chord, said lines being parallel with corresponding radii connecting the ends of the arc, said vertical and horizontal lines being extended to intersect the arc, and including the curvature of the boat surface between the vertical and horizontal lines. Ten claims.

856,586. SECTIONAL PROPELLER. EDGAR HUMPHREY AND MAURICE R. WILLIAMS, CORDOVA, ILL.

Claim 1.—A propelling device for ships, comprising a rotatable shaft, a sectional hub provided with blades, each end of the outer periphery



of the assembled hub having the form of the frustum of a cone, collars provided with frustoconical recesses, mounted on said shaft and engaging the ends of said hub, locking means for securing said parts in place. Three claims.

857,478. VESSEL. JOHN McARDLE, SAN FRANCISCO, CAL.

Claim 2.—A vessel comprising a frame provided with overhanging ways, a bearing having flanges cooperating with the ways, a shaft comprising a plurality of hinged sections, one of said sections being journaled on the frame, and the other in the bearing, floats carried by the shafts, and means for moving the bearing. Fourteen claims.

857,482. WATER-WHEEL. ALONZO H. PERRY, KINLOCH PARK, MO.

Claim 3.—A water wheel having feathering paddles adapted to become radial by folding inward each paddle being pivotally supported intermediate of its ends, means to prevent the paddle from folding when out of the water and capable of releasing the paddles when the latter enter the water, and means to hold the paddles against folding when they first enter the water until they become submerged below their pivotal axes. Nine claims.

British patents compiled by Edwards & Co., chartered patent agents and engineers, Chancery Lane Station Chambers, London, W. C.

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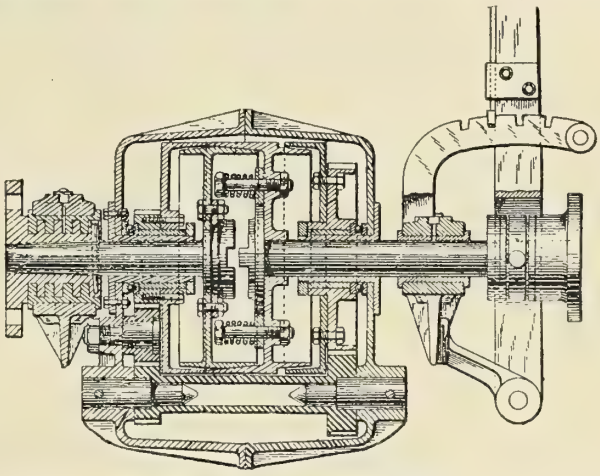
527. REVERSING GEARING. J. VAN TOLL, AND O. MAYER.

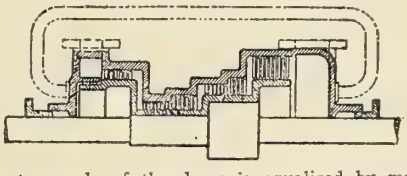
This relates to reversing gearing, specially applicable to motor-boats, of the type in which the forward speed is a direct drive through a clutch and the reverse is effected through auxiliary clutches and a countershaft. Double friction clutch members are secured to the driving and driven



shafts. For the forward speed, the shaft is thrust to the left when the members engage. Further movement of the shaft causes a positive clutch member to move outwards against the action of springs into engagement with a member on the shaft. Clutch members connected by a casing and adapted to engage with the free surfaces of the other members are secured respectively to loose toothed wheels, which gear respectively with a wheel on the countershaft through an idler, and directly with a wheel on the countershaft which is carried by pins projecting from the slidable but non-rotating casing, which bears against the outer sides of the wheels.

767. ELASTIC FLUID TURBINES. O. RICHTER.

The high-pressure part of a multiple expansion turbine is formed as an impulse turbine, while the succeeding stages are of the reaction type.

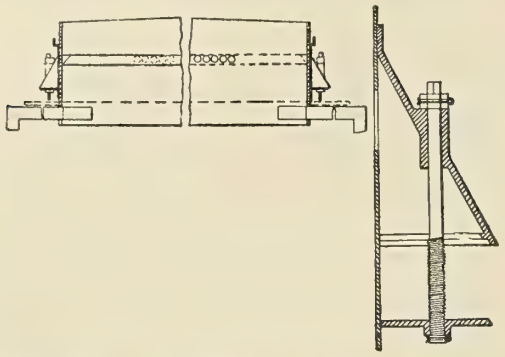


Pressure on the two ends of the drum is equalized by means of a pipe. In modifications, the low-pressure part may be conical or of curved

profile, and the high-pressure part may itself be in two stages. Labyrinth packing is used in the turbine between the blades and guides. In four modified constructions the direction of flow of the steam is reversed within the turbine between the high-pressure and the low-pressure parts.

1,026. VENTILATING SHIPS. W. F. McINTOSH, AND D. ALLAN.

Ships' holds are ventilated by apertures formed in the coaming of the hatchway and covered by hoods to keep out rain, etc. A gutter is formed below the apertures to catch moisture or condensed steam rising from the hold, and to discharge it through the apertures. Each hood is provided



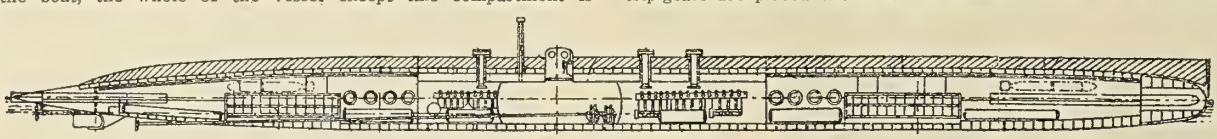
with a closing plate or valve attached to a screwed spindle by which it may be adjusted. Pipes are fitted to the hatchway and communicate with the between decks and hold, which are thus ventilated. When the valves are open, the wind blowing in at one side forces out the air within through the apertures on the other side, causing a draft and promoting ventilation.

2,406. INTERNAL-COMBUSTION ENGINES. W. J. CROSSLEY, MANCHESTER, AND J. ATKINSON, GLENBURN.

Governing.—The gas valve is closed by a spring and opened by a rod acting through another spring only when air is admitted to a dash-pot on its stem by means of a small valve under the control of the governor. The gas valve surrounds the stem of the admission valve and carries a piston working in a cylinder, to which the auxiliary valve controls the admission of air. A collar on the admission valve tends to open the gas valve through a spring, and to close it by acting through the cushioning-spring and piston.

2,467. SUBMARINE VESSELS. E. KOLBASSIEFF, CRONSTADT, RUSSIA.

A submarine vessel is fitted with a buoyant deck of porous material, e. g., a mass of cork. This buoyant material constitutes the chief element of buoyancy, and may be covered with armor. In the interior of the hull is arranged a cylindrical compartment, which is occupied by the crew when the boat is submerged. This compartment also contains the motor and steering-wheel. At the sides of the compartment are arranged compartments for the oil motors and crew, when the boat is afloat. To submerge the boat, the whole of the vessel except this compartment is



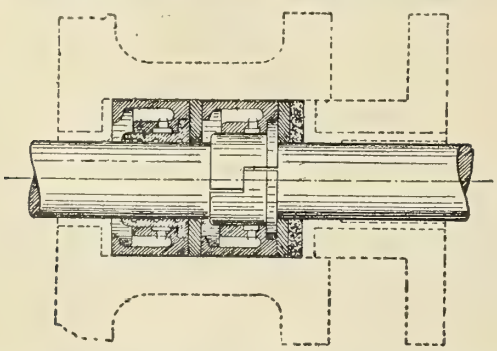
flooded. Ventilating pipes are fitted for use when the vessel is semi-submerged. An important feature is the arrangement of the accumulators, which, in addition to feeding the motors, serve also as detachable ballast weights. They are suspended by hooks in the underside of the deck, so that they may be instantly detached, and fall through the wells in the bottom of the vessel, thus enabling the vessel to rise to the surface.

2,528. SCREW PROPELLERS. T. GRIFFITHS, ABERAYRON.

Screw propellers are formed with two helical blades of length approximately equal to their diameter and having a pitch angle of approximately sixty degrees. In a modification, the propeller is formed with three blades having a pitch angle of forty-five degrees approximately.

2,672. STUFFING BOXES. O. KLAUSER, LONDON, W.C.

Stuffing box packing consists of one or more divided sleeves each held in a shell capable of some movement in the stuffing box, and having



passages to enable the steam to act on the sleeve, which is grooved for lubricant. A disk with a flared opening is placed between the two shells, and another disk and a leather washer are placed beneath the gland.

2,772. VALVES. F. W. SEYBOTH AND E. K. A. BAUMANN, ZWICKAU, GERMANY.

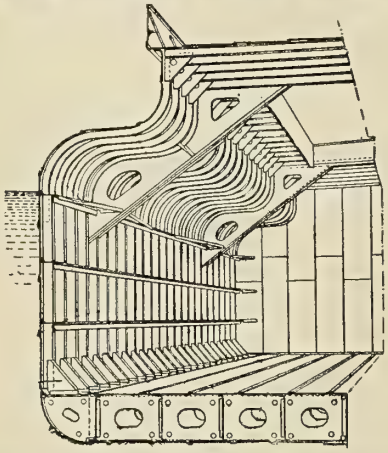
Relates to emergency cut-off valves which close by the rush of fluid when a pipe breaks. The valve, which is of the lift type, is formed with, and balanced by means of, a hollow cylindrical stem working in an axial cylindrical guide, the annular space communicating by passages with the discharge side of the valve. The valve falls by gravity and just floats freely in the steam current during the normal consumption. Should the pipe break, the valve is closed by the action of the escaping steam on the underside of the valve. The steam or water in the annular space acts as a buffer so that the valve is closed gently. To close the valve by hand, a three-way cock is turned to discharge the annular space into the atmosphere, the valve then closing by the steam pressure on the underside.

2,868. SCREW PROPELLERS. G. PERTOT, MILAN, ITALY.

The propellers of ships, aerostats, and torpedoes are placed towards the stem, at about one-third the length of the structure, with the shafts inclined, and are driven by turbines. Two propellers are preferably fitted, one on each side of the keel. In the case of large vessels, four or more such propellers are used.

3,085. SHIPS. C. D. DOXFORD, SUNDERLAND.

Frames and framing.—In turret vessels having no beams or stanchions in the holds, the deep web frames and lower gusset-plates are dispensed



with. Large gusset-plates extend from the frames to the deck beams at intervals, and are supported by brackets. Knee-plates connect the frames to the double bottom.

3,817. STEAM-ENGINES. W. EASTWOOD, LEEDS.

Valves and valve-gear.—To facilitate the application of trip-gear to semi-high-speed engines, two alternately-operating gears are employed at each end of the cylinder, in connection with either one or two admission valves or with one valve and its movable liner, which operates as a valve. In the single-valve arrangement, the valve spindle cross-head is alternately operated by two levers on the pivot, moved by catches attached to the forked ends of the rods, which are operated by eccentrics or cams on a half-speed countershaft, the catches being released by a bar on levers controlled by hand or the governor. In a modification, the trip-gears are placed one above the other.

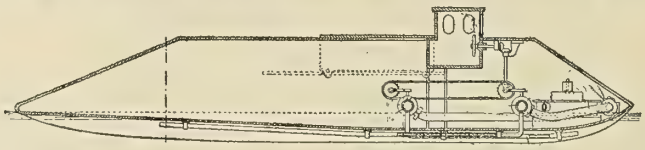
3,453. SHIPS. M. W. AISBITT AND J. W. SHOTTON, CARDIFF.

Bulkheads; bunkers.—Between two longitudinal vertical or nearly vertical central bulkheads placed comparatively near to one another is fitted a horizontal floor. This construction provides a tunnel beneath the floor, extending from the machinery spaces to the fore and aft peak

bulkheads. The after tunnel is used as a screw tunnel, and the forward tunnel may be used for the purpose of ventilating or cooling the cargo disposed in the compartments above it. When the space between the bulkheads is used as a coal bunker, the floor is fitted with doors having sloping roofs to support the coal, and relieve the doors of pressure.

4,231. PROPELLING &c. SHIPS. F. W. SCHROEDER, LONDON.

Propelling and steering by air and gas jets.—The propulsion and steering are effected entirely by means of compressed air, which escapes through inclined holes in pipes arranged longitudinally on the underside of the vessel. The bottom is preferably flat, and is inclined upwardly and arched transversely towards the stern. In order to provide for forward and rearward propulsion, two sets of tubes have, respectively, rearwardly and forwardly directed orifices. The tubes are separated by webs,



the central web and side webs being deeper than the others, so as to support the ship when beached. A reservoir, supplied with compressed air, communicates through pipes and valves with transverse supply pipes. The valves are operated from a steering-chamber. The exhaust gases from the motors may be used to supplement the compressed air, by being discharged either into the air tubes, or into a separate tube or tubes, which may be arranged to be raised out of the water for starting the motors and afterwards lowered into the water.